WORK

An Illustrated Magazine of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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GESSO WORK.

A NEW MODE OF DECORATION IN LOW RELIEF.

BY E. C.

A FRESH kind of art work is interesting since the love of novelty and of research is inherent in most natures. Artists, and workmen of the more intelligent sort, enjoy finding out what effects they can secure with any new materials or tools they may have at command. Amateurs especially delight in the latest inventions, and many even cannot resist the temptation of trying each novelty in the way of minor arts as it is brought out, thus making it a foregone conclusion that they will be proficient in none until they cease to play the part of "rolling stones." Still, I do not consider such flitting from one occupation to another as altogether deserving of the scathing condemnation bestowed sometimes upon it. If only at last the butterflies will settle down in earnest to a congenial pursuit when they discover it, they will be none the worse for the smattering of knowledge they have gained. It is not always the case that we can find at once our own nook in the midst of the labourers; having done so, let us fill it to the best of our ability.

As I have been asked to write for this Magazine a paper on "Gesso Work," I am pleased to do so, because I am sure that the art as applied to decoration has a future before it, and those who become by practice competent to execute thoroughly good specimens, will have a pretty safe chance of earning something better than a mere livelihood.

Now I cannot claim for gesso work the charm of novelty since it is ages old, but it is tolerably new to us (last year, I think, the first examples were exhibited in England) as regards its adaptability to furniture and house decoration. Here is the opportunity for those who enter the lists to make their mark; and women may succeed quite as well as men.

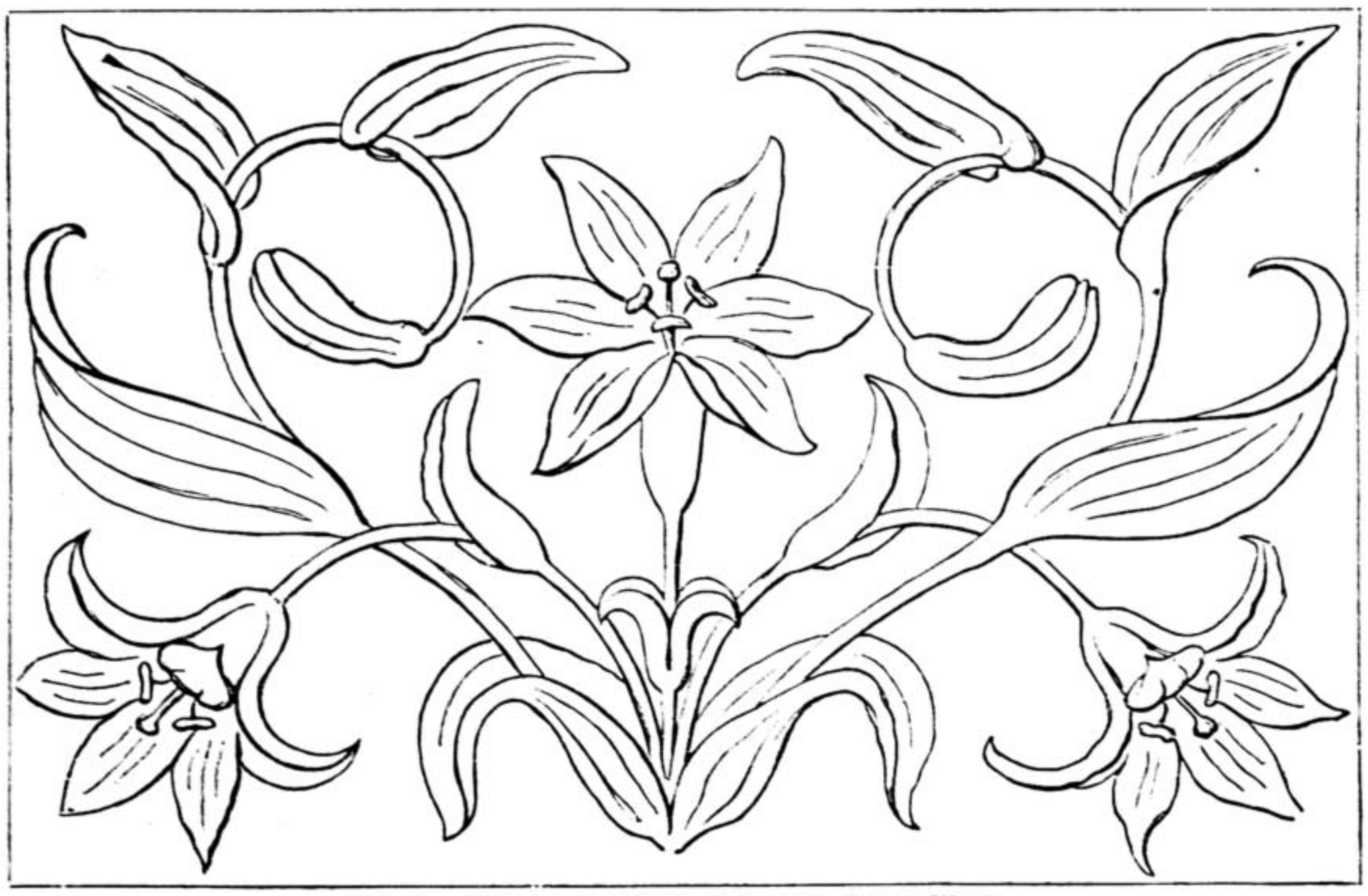

Fig. 1.—Panel for Piano Front in Gesso Work.

Gesso is composed of the finest plaster of Paris and glue. The mixture, which should be of the same consistency as cream, is laid on the surface of sized or lacquered wood with a brush. Two or more coats may be applied to bring the decoration into higher relief, and whilst still soft the composition can be modelled with the brush. It can also be left flat, when it forms a good white ground for painting on. A composition for gesso work has just now been brought out by the Society of Artists, 53, New Bond Street, W. This is prepared so that it will not harden too quickly to allow of its being carefully modelled. It takes about half an hour to dry. Gesso is difficult and troublesome to prepare at home, and it takes up a considerable amount of time, so it is far better for learners, at least, to use the ready prepared composition. Hogs' hair and camel hair brushes are used for the work, and often the gesso is laid on with the palette knife where a high relief is desired.

To gain some conception of the appearance of a piece of gesso work when completed, we can imagine a plaster cast, such as is employed for teaching drawing in schools of art, decorated with silver and gold, and tinted with metallic colours. The effect, when the work is well executed, is rich and harmonious. It is quite possible, of course, that instead of being harmonious it may be garish and vulgar; but this is the case with all work if artistic feeling is not brought to bear upon it; the worker alone is to blame if a pleasing harmony is not secured.

I will describe a few of the different methods of gessoing that will be of practical use to those attempting it for the first

Fig. 2.—Decorative Frieze for Drawing-Room in Gesso Work.

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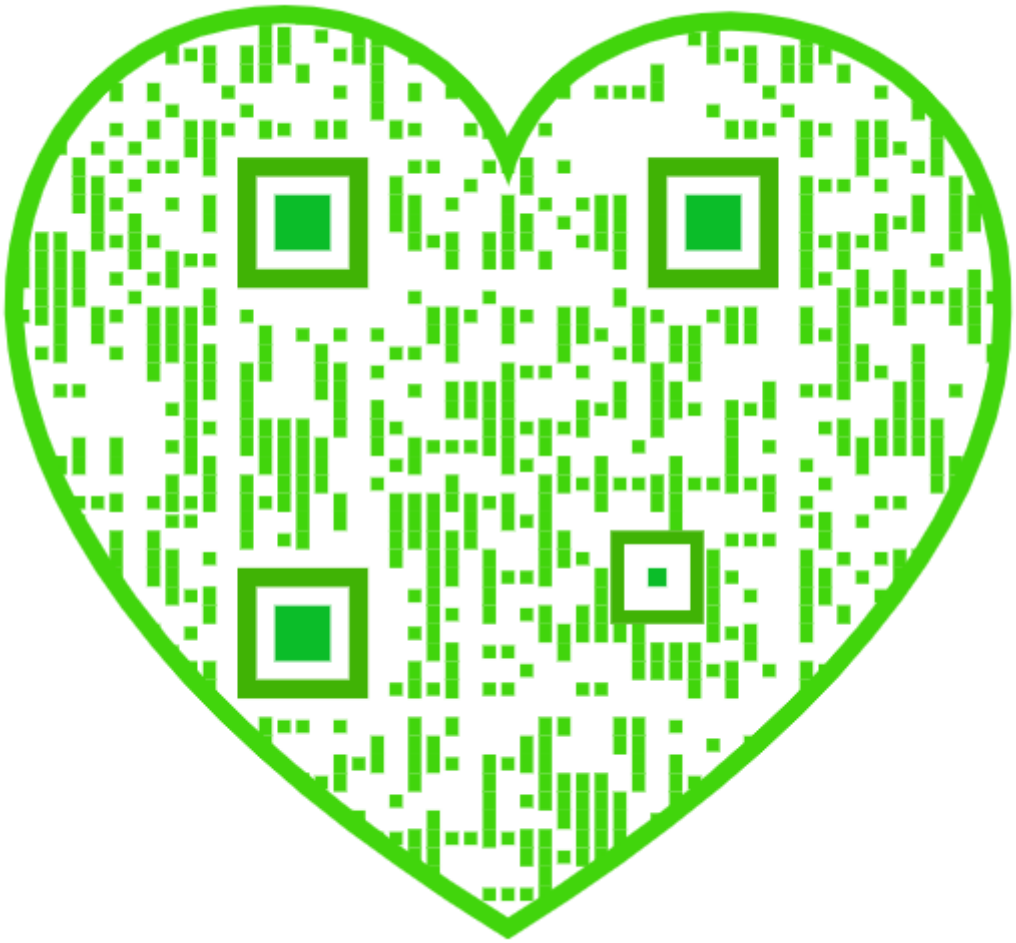


time. Take a panel of wood, and lacquer it green. The term lacquer is rather freely applied in our day. Metallic colours, when sized and varnished, are called lacquers. On the green ground model the design in gesso; let it dry, then silver it, adding touches of gold to bring out the pattern. Or the design may first be sketched on the panel, the gesso laid and modelled, then the background laid in, and, lastly, the gesso silvered and gilded. This is one of the simplest styles of panel that can be executed.

Workers will find that they can get good ideas for designs from some of the best Japanese papers. Large scrolls, arranged on decorated backgrounds, are effective. Beginners should avoid falling into the common error of designing in a finicking manner. Let the treatment of the subject be broad, and free, and strong. Gesso is not fitted to the carrying out of minute details. Still, the decoration can be far more elaborate than that which I have suggested for a first trial. Here is another hint to be followed when a little experience has been gained.

Get a panel of wood, and cover it all over with gesso. Rapidly sketch the design. Now model on the background a set pattern in low relief, after the style of old illuminations or pictures of saints. Next fill in the design with gesso in higher relief and let the whole set. The gesso composition will take the colours more easily if it is sized, but this is not indispensable always. Silver the background, gild the set pattern, and tint the design, which is in high relief, with emerald or serge blue, relieving it with copper gold in parts. If it is desired to get a bright effect, size and varnish the panel; if not, the gold alone can be sized; this renders it more permanent. Nothing more is required in the way of finishing, so it will be understood how easily and quickly gesso work can be accomplished—a great desideratum in these days of hurry and bustle.

Metallic colours are sold, ready prepared, in small tins at 1s. each. A number of extremely beautiful tints are made. Amongst them may be found an exquisite salmon hue, serge and forget-me-not blue, lilac, emerald and bronze green, reds, and a peculiar parrot green. Then there are silver, gold, and copper gold; the latter is particularly effective on a gesso design that has a silvered background. In using the colours, pour off some of the liquid, turn out on to the palette as much of the colour as is likely to be required, then put the rest of the liquid back into the tin; this keeps the colour in good condition.

The white powder and the composition must be well mixed; if too much of the latter is added to the powder a high relief cannot be secured. The brushes and palette are cleaned with turpentine.

The worker has it in his power to obtain charming effects by shading his backgrounds from silver to blue, or by graduating the tints from light blue to dark blue, or from salmon to bronze. A background again may be entirely gilded, or silvered, or coloured any desired shade. When the gilding or silvering is chosen, the ground may be the plain wood or the gessoed wood. It is unnecessary to gesso the panel for gilding or silvering unless a decorated background is wanted; in the latter case the decoration is first moulded, or incised, on the gesso ground, and the whole is then coated with gold or silver.

The design in its turn may be silvered, copper gilded, or gilded. The indentations may be accentuated with colour. Yet again the design may be tinted with one or more colours relieved, or not, according to the artist's fancy, with gold or silver, or copper gold.

It can be seen from the above that a gesso worker is able to produce greatly varied effects, and the decoration, consequently, is well worthy of study. The objection of its costliness will keep it from becoming common, but there are many who will be disposed the more on this account to pay a good price for artistically executed specimens.

The amateur worker is likely to fall into the error of attempting to secure too high a relief. This he should guard against. For a frieze a high relief is desirable; for a panel intended for piano, low relief may be infinitely preferable. Some artists do not model the gesso at all, but lacquer, silver, or gild it flat; others, in certain portions of their decorations, introduce cotton wool, sometimes for the purpose of securing higher relief, and sometimes to obtain a particular effect. For example, Mr. Walter Crane employs cotton wool in his frieze panel, "St. George and the Dragon," in representing the texture of the dragon's wings with excellent result. The wool is dipped into the preparation and laid on the work, slightly modelled or not as the case may require.

One more suggestion to the worker. Try the effect of a gesso design, lacquered or silvered, or both, on a stained or polished wood panel. Those who are clever at drawing or modelling figures have great facilities here for showing their skill, and the draperies afford opportunities of composing rich harmonies of colour.

Pieces of furniture, caskets, ornaments, flower boxes, photo frames, are some of the articles that can be beautified with gesso work. I could add a long list were it not wearisome to read such, but hundreds of things will suggest themselves to readers as appropriate for gesso decoration.

Before executing the illustrated frieze, it is necessary to know the scheme of colour of which it will form a part. As this, however, is an impossibility for me, I will describe how it can be carried out, and workers must substitute other colours for those I mention should they not harmonise with the scheme proposed for the room decoration. We will suppose, for the sake of making the directions as clear as possible, that the scheme of colour chosen is tawny orange, with two shades of blue, the woodwork is painted white, the walls covered with white and gold Japanese paper. The frieze should be treated after this manner. First gesso the ground entirely over, then model the design and bring the grotesque creatures into much higher relief than the foliage. Use the palette knife freely in laying on the gesso, as it saves time. When all the frieze is so far prepared, set to work to colour it. A coat of size will be advantageous, as the gesso will then take the colours easily. There are several ways in which the frieze might be tinted. I should colour the creatures serge blue and gold, the foliage gold and copper gold; then silver the background. Or the ground might be forget-me-not, foliage gold and copper gold, and creatures silvered. The draperies employed with this scheme should be tawny gold plush, the carpet two shades of blue (Wilton), the chair coverings silvery grey, ground with blue and gold in the design. A few touches of red will be required to complete the harmony.

As gesso work is by no means an inexpensive decoration, I strongly advise those who wish to turn the art to practical account only to execute one portion of the frieze (it should include the entire design), as a completed sample is all that is necessary to submit to decorators.

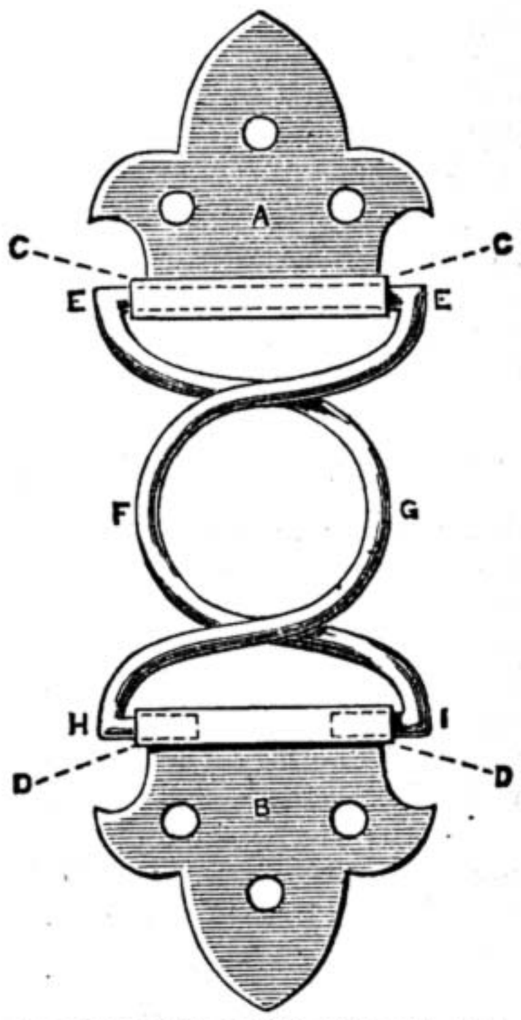
The "Lily" Panel is very simple, and most suitable for a beginner to try his hand upon. The design should not be in at all high relief, although well raised and well modelled. The lily may be painted white and the foliage green on a gold background, or the flower may be silvered, the foliage gilded, and the background tinted emerald or blue. But here again, if it is being done to fill a particular position, the surroundings must be taken into consideration. For my part I prefer the second suggestion for colouring the panel, as gesso work should be as conventional as possible to be truly decorative. Naturalistic effects are not desirable.

A NEW FASTENING FOR LETTER-CASES, ALBUMS, ETC.

BY INVENTOR.

In the district where the writer lives there is a constant demand for novelties in the way of "fancy cases," and it has been part of his vocation to supply models of these to manufacturers. In very many instances a new fastening is asked for, but to invent anything novel in this direction being a great tax upon the brain, it is seldom obtained.

In the course, however, of trying to devise a new means of readily fastening and unfastening a needle-case, the writer invented the clasp shown in the annexed illustration, and, though too large for the purpose for which it was required, he thought it would be very suitable for letter-cases, albums, and other articles, and as such it is presented to the notice of the readers of WORK.



New Fastening for Albums, etc.

The construction of this clasp is simple enough, and the model was made by a person possessed of only the ordinary tools which a workman might be supposed to have in his own house. The top part, A, and the lower part, B, were cut out of sheet brass, each long enough to allow of the rolling over of their straight side into a tube, as shown at C C and D D.

Before forming these tubular portions of the clasp it was necessary to bend a piece of wire in the manner shown at I F E E G H. The tube, C C, was then folded over the part of the wire marked E E, and the tube, D D, formed in a similar manner to receive the ends, H I, of the wire.

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By an inspection of the illustration it will be perceived that the clasp is there shown as fastened, and it is equally apparent that a slight pressure of the thumb and finger upon F, G, will cause the ends, H, I, of the wire to be withdrawn from the tube, D, D, and the clasp will be unfastened.

This clasp has the advantage of not by its form showing to every one the mode of unfastening it. In fact, to all who have seen it for the first time it appears to be not only a clasp, but an ingenious puzzle.

PAPIER-MÂCHÉ.

HOW TO MOULD, AND HOW TO ORNAMENT IT.

BY SYLVANUS WARD.

DECORATION (*concluded*)—SKY AND WATER EFFECTS IN BRONZE WORK—FANTASTIC CHINESE ROCKS AND RUGGED GROUND IN BRONZE—INTERIORS IN BRONZE—PAINTING IN POWDER COLOURS—PAINTED ORNAMENT RELIEVED WITH GOLD AND BRONZE—SPANGLING—PAINTING, GRAINING, AND MARBLING—FINISHING.

Bronze Work (*continued*).—There is another way in which bronze powder may be applied—by a stencilling process which is the converse of that already described. To effect this, the ornament is not, as in the former case, cut through the stencil plate, but is left remaining, whilst the other parts are cut away. The plate thus formed is laid on the work, and the bronze powder is dusted upon those parts which are not protected by it, and shaded off till it dies away in the general ground. In this work a white bronze is used, and afterwards stained with some transparent colour. The ornament is thus left black; and purple, which harmonises well with black, is a good colour with which to stain the bronze. The result is a rich velvety effect.

Fig. 44 shows the principle on which a stencil plate for this kind of dusting-in should be cut, which, it will be observed, is very much that of fretwork. The form given may either serve as a "repeat" in a running pattern, or as a quarter of a quatrefoil. The dots would be pierced, and would show on the work as solid bronze.

Sky and Water Effects in Bronze.—By bronze work something of the glowing effect of evening skies is to be attained in a much more rapid manner than by colours. In that part of the work where the light is supposed to be most brilliant—that is to say, in the lower part of the sky—the bronze powder is first dusted-in pretty solidly. In depicting such skies, the sun himself is not usually shown; but if he does appear, he must be put in quite solid—indeed, gold powder is best for the luminary, put in with a "stump." The brilliant variations of hue seen in sunset or sunrise skies are readily reached by using different bronzes, the brightest touches on the sunlit clouds being put in last of all with gold powder and a "stump."

It may, perhaps, be well to explain the "stump" used for this work, which has nothing in common with the little roll of wash-leather used by the ordinary draughtsman, and called by the same name. The japanner's stump is a small camel-hair pencil (say, of the same size as that previously mentioned as a "sprigger") which has been cut off almost close to the quill—as near, perhaps, as the tenth of an inch—and which has then been rubbed down to a rounded, or rather convex, shape on a pumice stone. It will be found useful for many purposes in bronze work, besides those of which we have spoken of.

By using a white bronze an approximation to the effect of water may be produced in much the same way, and the resemblance increased by adding a bluish shade with transparent varnish colour.

Fantastic Chinese Rocks and Rugged Ground in Bronze.—Fantastic rocks of the type shown in Fig. 45—forms derived, like the art itself, from the far East—have been of frequent occurrence in japanned work, and they are produced by first pencilling-in with gold size, and then dusting with bronze. Sharpness and decision are afterwards given to the masses by touches here and there of pencil bronze. In Fig. 45 the dark strokes denote this pencil bronze work; and as the example before us is necessarily on a *white* instead of a *black* ground, the greatest depth of shade in it represents what would be the lightest part of the actual bronzed work. This will equally apply to Fig. 46. Throughout these articles the fact that papier-mâché gives a *black* ground, whereas the printer's paper gives a *white* one, has been a serious bar in the way of efficient illustration.

Rugged or broken ground (Fig. 46) is worked in bronze by first sizing over the space with gold size; then a piece of paper is taken, and cut to an irregular outline, something after the fashion of Fig. 47, for use as a stencil plate. This is first laid at the bottom of the work, and bronze is dusted on, thickly just at the edge of the paper, but it is allowed to die away beyond. Then the stencil plate is moved a little higher, and the process repeated; and this is done again and again till the required space has been covered. The desired effect is thus easily attained, and a few bold strokes with pencil bronze showing as blades of grass on the summits of some of the irregularities, etc., gives an amount of conventional completeness to the representation. This, like the rocks, is Chinese in its origin; the Willow-Pattern Plate shows vestiges of it.

Interiors in Bronze.—Interior views of buildings, and more especially of such buildings as Gothic cathedrals, are capable of being made highly effective in bronze work. The proper mode of procedure is first to lay in the light side of the interior pretty solidly with bronze powder in the usual way, and to shade off to the darker side. If the pillars stand out in light, they should be stumped with gold powder or pale bronze. At this stage a thorough drying in the stove is desirable.

The details will now have to be sketched out with approximate accuracy, and, as in work of this sort straight lines are sure to abound, the straightedge will of course be freely used. The blacklead pencil will be found to mark well on the bronze, which has that sort of roughness commonly spoken of by workers as a "tooth." And now, where rays of sunlight streaming in through the windows make brilliant patches on pillars, walls, etc., such patches should be laid in with gold size and gilt with pale gold. If, as is most likely the case, our interior is that of some Gothic minster, one of its most striking features will doubtless be a stained-glass window. This, with the means at our command, can be rendered highly effective. The lights—the glass portions, that is—of the window we lay in with gold size and cover with silver leaf, which will enable us by-and-by to colour them most brilliantly.

Our window, being that feature of the composition which most catches the eye, will be the one on which to work first, the other parts being afterwards brought up to and made to harmonise with it. The mullions and tracery should first be put in to serve as frames for our representations of stained glass. These, which will show quite dark, must be put in with black paint, in which is a mere touch of bronze powder, just sufficient to preserve its affinity with the surrounding bronze work. The figures or other designs of the stained glass can then be painted in with transparent colours on the silver leaf. The scale will, of course, rarely be one to allow more than mere indications of such designs to be brought in; but slight as they may be, the effect produced will be one of much richness and beauty.

Figures in rich vestments are sometimes introduced, and these can also be laid in with silver leaf, and stained with transparent colours as above; but these can never be made to arrest and delight the eye like a window.

But to return: our glass being stained, the parts of the structure immediately surrounding our window will next have to be worked upon with a mixture of bronze and some little transparent colour. The parts in light are then proceeded with, bronze paint being used—that is, bronze powder mixed with copal varnish, and applied just as paint might be. In some of the light parts (such as those pillars which are to the front, and being in light show most prominently) the bronze will have to be laid in quite solid, in order that it may as nearly come up to those parts which are gilded as is demanded by artistic effect. On the more receding pillars, etc., the bronze will have to be so reduced as to allow them to recede into their proper places; either using less bronze, or mixing the bronze with transparent colour, will enable the decorator to effect this.

Painting in Powder Colours.—Our remarks on bronze work may properly be followed by some information as to the methods of using colours which, like the bronze, are in a powdered state. Papier-mâché decorators have chiefly used powder colours for two purposes:—Firstly, for groups of flowers, in which the effect has been almost wholly dependent on this process; and, secondly, for views of interiors, in which this process has served as little more than a preparation and background on which the finished result has been attained by other means.

As an illustration of flower painting in powder, let us suppose that the object to be represented is a red rose. There are three ways in which we may set to work:—

1st. The block form of the flower is laid in with tube oil colour (flake white) to which a little varnish has been added to make it dry more quickly. On the ground thus formed a single petal is pencilled-in, and powdered colour is dusted upon it—it being applied most thickly in those parts where most colour would appear in the natural petal. This has to be dried. A second petal is then coloured in the same manner, and also dried; and so on till the rose is completed. This was the older process. It was necessarily a slow and laborious one, but no other process equals it in softness and beauty of effect.

2nd. With tube colour (flake white) mixed as before, the whole rose is painted in so as to have somewhat the appearance of a white rose, and upon this powdered lake is dusted. The parts most strongly painted in white will appear to come forward, and the others to recede. The finishing is done with brush and tube colour.

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Fig. 44.—Bronze Work: Ground Stencilling.

3rd. The rose is solidly blocked in throughout with the white paint, and on this the dust is then placed and shaded down with the brush. A dead representation of the flower is thus obtained.

Powder colours give a softness of effect not attainable by any other process of painting, and they can be used expeditiously.

With regard to the application of this process to interiors, not many words of explanation will be necessary. The whole has to be painted in with the tube flake white mixed as above, and powdered colours are dusted on. It is afterwards finished when dry with moist colours. Silver leaf is sometimes introduced in interiors thus painted, as it is in those done in bronze. Indeed, dusting-in with bronze and colour may be said to be really one and the same process, the material only being varied.

Painted Ornament Relieved with Gold and Bronze.—A method of decoration sometimes adopted on large articles is to paint the ornament in colour—usually a brown (burnt umber) or a bronzy green—and to give brightness and variety by relieving it in parts with gilding and bronze. Fig. 48 may serve as an illustration of this kind of ornament. In this figure the simple tint represents the green or brown ornament, and the shaded parts those which are bronzed. On these latter, after the colour painting, the bronze powder is dusted in the usual manner, and a drying in the stove or otherwise is necessary. The ornament is then almost wholly outlined and lighted up with gold, as shown in Fig. 48, where gilding is represented by black. A considerable amount of gold sprigging around or in connection with the ornament is often added with good effect. This is also exemplified in the illustration.

Spangling.—Among the showy methods of decoration used on papier-mâché is the employment of gold spangles. These the decorator readily makes for himself by following the ensuing directions :—

Take a glass bottle, and, having made sure that its outside is thoroughly clean, gild it wholly or in part, according to the quantity of spangles required. The gilding will be done with leaf gold and isinglass size, in the manner recommended for bright gilding on papier-mâché. After burnishing as directed in connection with that process, varnish the gold all over with copal varnish, and dry in a stove or warm room. When the varnish is quite set, fill the bottle with cold water, and let it stand for a night in a cool place. By this the varnish will be rendered brittle; the bottle should then be held aslant and scraped upwards with a knife, which will cause the varnish to fly off in small flakes, bringing the gold with it. The spangles thus formed will be of a brilliancy not to be surpassed; and should they be too large for use, they may be reduced in size by rolling and crushing under the thumb in a piece of paper. There are many purposes, apart from the decoration of papier-mâché, to which such spangles may be applied.

On papier-mâché they are thus used:—The space to be spangled is gone over with copal varnish, to which a little oil has been added, and this should be laid on carefully and evenly. Spangles, in order that they may adhere properly, demand, it should be remembered, a much more moist surface than is required by gold leaf; the ground must, therefore, be only partially dried; and when it is ready, they are to be dusted freely on with a camel-hair brush. The dry brush will readily remove those which do not stick, which will be none the worse for future use. Nothing more is required except drying in the stove or otherwise.

Fig. 45.—Fantastic Chinese Rocks in Bronze.

Fig. 46.—Rugged Ground in Bronze.

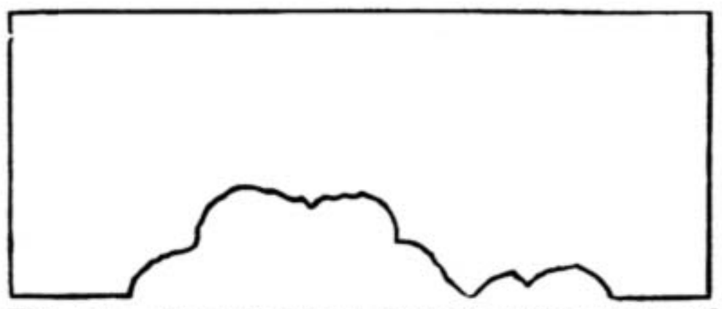

Fig. 47.—Stencil Plate for Working Rugged Ground.

Spangles thus used have a rich sparkling effect.

Painting, Graining, Marbling, etc.—For painting in the ordinary manner with ordinary colours, papier-mâché forms an admirable ground, though those brighter and more showy methods of decoration which we have described, and to which it lends itself so readily, have ever been more in favour for ornamenting it. This is not the place in which to give any treatise on ordinary painting, and there are no special points in regard to its relation to our material to be noticed. Nor need much be said here with respect to graining or marbling, both of which have been practised on papier-mâché. In the matter of marbling it may, however, be observed that the spangles named above will be found useful, sparingly used, in giving imitations of lapis lazuli, as furnishing the sparkle of the natural stone. Malachite, like the foregoing, has been a favourite stone for imitation on papier-mâché, and in passing we may mention that the dark rings which distinguish it may most readily be produced by applying the finger end and turning it round; withdrawing it abruptly will then form the dark spot which occupies the centre of the ring.

Associated with graining is a way of imitating inlaid woods which first came under the writer's notice in connection with papier-mâché work, though he has since seen it applied to other purposes; this also may be worth a passing word. The space is first grained all over with graining of one kind—say, maple—and, when this is dry, those portions of it which are to appear as inlaid are painted over with a kind of paint made with finely-powdered rotten-stone mixed with treacle or sugar. On this, when dry, a second entire coat of graining is given to the space—say, this time, of walnut. If, when this is set, the article is damped, the saccharine paint will come off and bring with it that coat of graining which lies above it. The result will be that the space will appear as of walnut, with inlaid ornaments in maple.

Finishing.—Whatever mode of decorating the papier-mâché may be adopted—whether pearl-inlaying, gilding, bronzing, painting, or a combination of any or all of these—the decorations will finally, with a single exception, have to be covered and protected with a coat of varnish. The solitary exception is when the decoration consists of broad surfaces of natural pearl not painted or otherwise embellished. These need no varnish, and indeed, if put over them, the varnish will be liable to peel off under changes of weather; it is the painting, etc., upon the pearl which binds varnish firmly to it.

If the decoration extends over much of the surface of the papier-mâché, the better plan is to take a broad brush and lay an even coat of varnish over the whole. If, however, the decoration is confined to detached portions, it is best to pencil the varnish over the ornaments only, leaving the ground untouched. And for this reason, the black japan varnish of the ground takes a finer polish than is to be got on copal, and therefore the more of it that can be left uncovered the better.

When the varnish is thoroughly dry, it has to be polished. First, to remove any slight irregularities, it is lightly gone over with a bob and wet rotten-stone; and after this has been swilled or wiped off with a clean wet rag, with powdered dry, hard rotten-stone; then with whiting powdered very fine and sifted through muslin. The dry

Fig. 48.—Painted Ornament Relieved with Gold and Bronze.

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rotten-stone and whiting should be carefully cleaned away with a silk duster. Lastly, a brilliancy not to be attained by any other means is given by friction with the palm of the hand lubricated with a spot or two of sweet oil. A woman's hand only is capable of doing this properly, and a hand of which the fingers can be bent well back.

The perfect brilliancy of surface reached by these means on well-finished papier-mâché is one of the distinctive beauties of the material; and when the article is in household use, this brilliancy should be preserved by wiping or dusting it only with a soft old silk handkerchief.

POLARISATION OF LIGHT AND POLARISCOPES.

BY O. BECKERLEGGE.

Polarisation of Light Explained.

THE subject which I have set before me to discuss for the readers of WORK is one beset with unusual difficulties. First of all, on the part of the reader, a great deal of preliminary knowledge is required in reference to the theory and physical properties

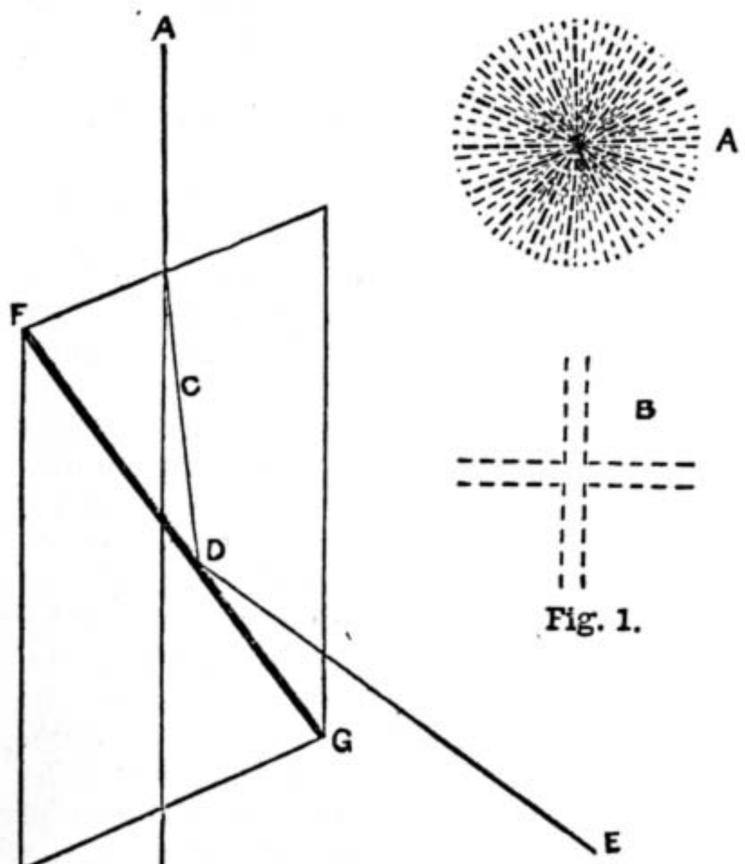


Fig. 2.

Fig. 1.

Fig. 1.—Beam of Light grossly exaggerated—A, Common Light with the Vibration Perpendicular to Line of Transmission; B, Ray Polarised, in which it is split into two, each Ray Perpendicular to the other.

of light. On the other hand, there are but few—the present writer included—who seem able to grasp the subject so as to lay it before the reader in a manner easy to be understood. It is a difficult subject. But it should be remembered that the scientific or philosophical instrument maker, as a rule, is not held responsible for the theory or its explanation, only so far as demonstration and the application of his instrument to the theory may be concerned. I, therefore, shall have no more to do with the theory than will be necessary to obtain an intelligent view of our work, my object being principally practical—to furnish those who wish to study more advanced treatises on the subject with the means of demonstrating by the use of instruments, and especially in conjunction with the microscope.

By polarised light, we understand light that has undergone some change by which it presents two distinct and opposite conditions

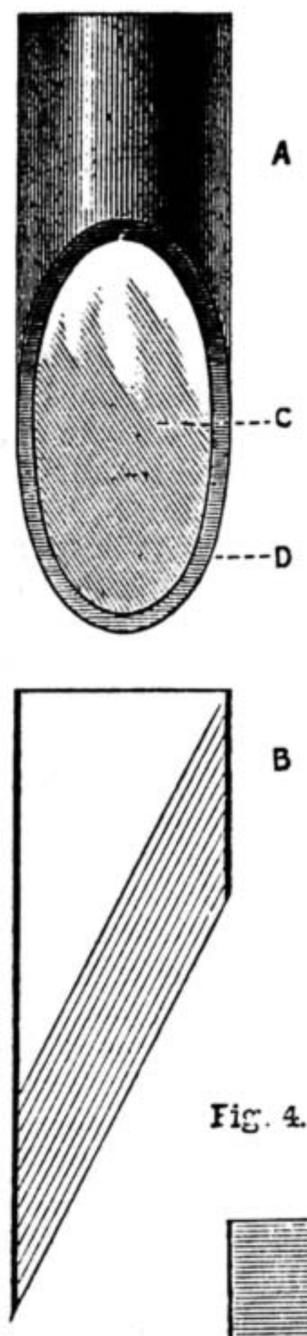
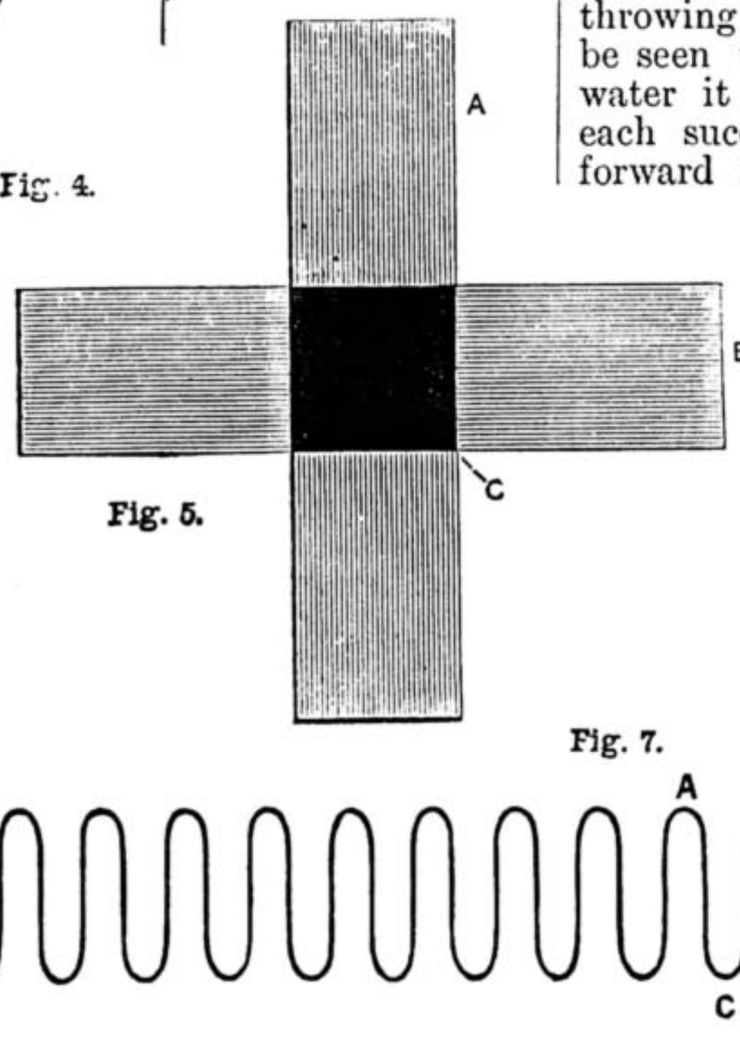


Fig. 3.

Fig. 4.



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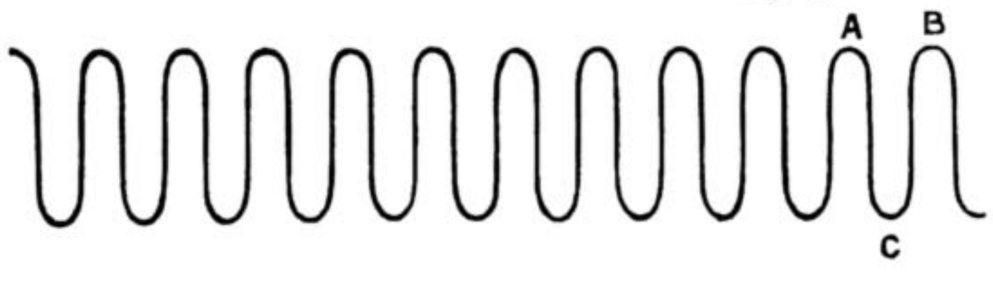

Fig. 7.

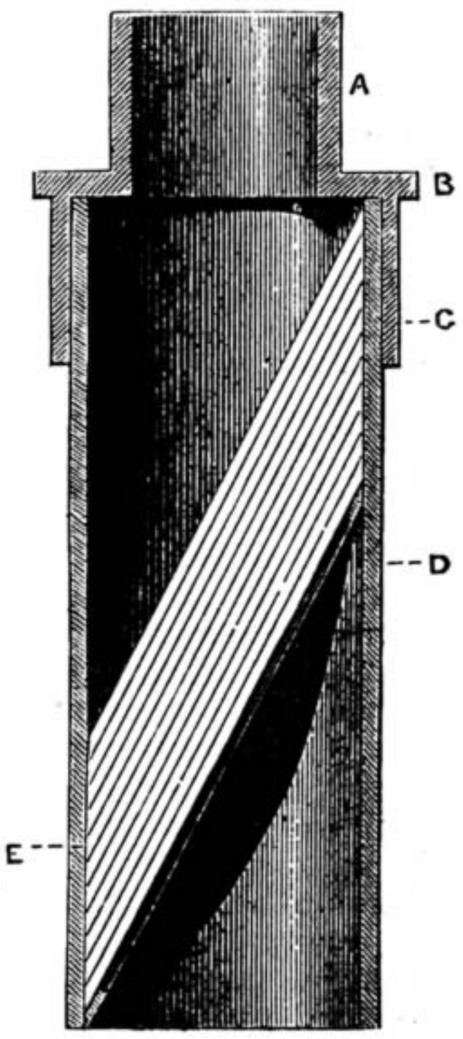

Fig. 8.

Fig. 8.—Diagram of Polariser for Microscope; A, Tube to put into Diaphragm of Microscope; D, Tube Carrying Films of Glass, E.

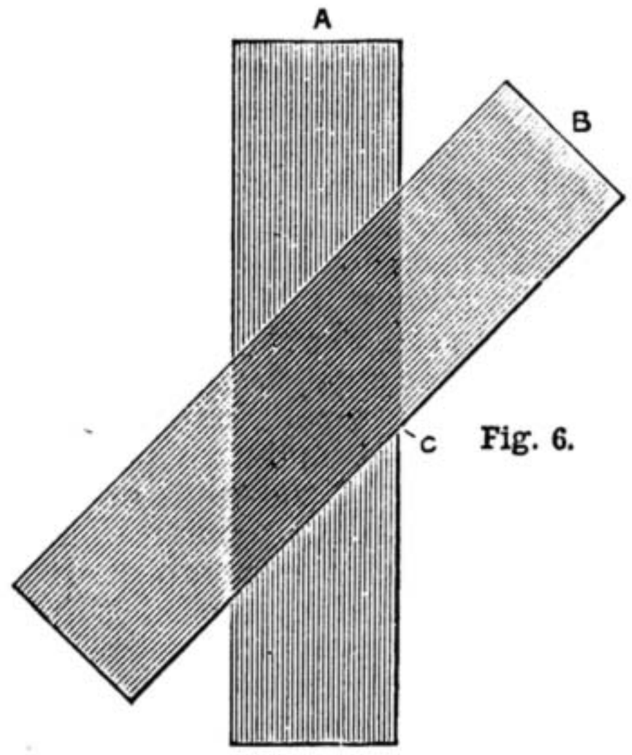

Fig. 6.

Fig. 2.—Rhomb of Iceland Spar made into a Nicol Prism—A, Direction of Ray of Light; B, Extraordinary Ray; C, Ordinary Ray refracted at D to E by Canada Balsam at Juncture F G. Fig. 3.—Diagram of Plates of Glass at Angle of 26°. Fig. 4.—A, Analyser; B, Section of Polariser; C, Thin Plates of Glass; D, Ledge to Support Glass. Fig. 5.—Two Plates of Tourmaline, showing the Light intercepted at C. Fig. 6.—The same, showing the Light Fading when partly turned. Fig. 7.—The Vibration of Ether grossly exaggerated—A B, The Length of the Wave; B C, the Amplitude.

or sides, the term being a figurative one, borrowed from the opposite ends or poles of a magnet.

It will be admitted that light is the result of an imponderable medium known as ether, thrown into a state of vibration. This medium pervades all space, and envelops every atom of matter. In the transmission of a beam of light, there is no forward motion of ether, but simply a progressive wave.

For example, in looking over a corn-field a wave will often seem to pass over it, occasioned by the breeze. A row of corn is slightly depressed for an instant, but as soon as the pressure of wind is gone it regains its upright position. The falling and rising succeed each other with great rapidity, and the eye takes cognisance of a forward motion, not of the corn but of the wave—the corn has simply moved in a perpendicular manner.

Another, and a familiar, illustration is the series of rings on water caused by throwing a stone into it. Now, it will be seen that if a straw is lying on the water it will simply rise and fall with each succeeding wave, but will make no forward motion, as it would if the water advanced. Light then is the result of the undulations or vibrations of ether. When these vibrations are conveyed to the brain through special nerves, we see. In ordinary light the vibrations take place in all planes perpendicular to the ray, Fig. 1, A. It may be further added that intensity of light is as the amplitude of the wave, or distance from the crest of one wave to the sinus or hollow of the next, A C, Fig. 7. The colour of the light depends on the number of vibrations. All are aware that in a ray of white light there are combined the three primary colours—red, yellow, and blue—and that they vibrate at different rates. Imagine a ray of light approaching the eye, if one may so say, end on, with the vibrations perpendicular to its path; this is common light. Let us now, by some means, split the ray into two, and cause one ray to vibrate perpendicular to the other. We shall find that whilst to the unaided eye there is no difference whatever, yet, when

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viewed under certain circumstances, there is a marked difference, Fig. 1, A B.

There are various means by which a ray of light may be brought into this condition. The means most generally employed are by refraction and reflection. Almost all crystals of the rhombohedron class will polarise, whilst those crystals belonging to the cube system, such as common salt, will not. Of all crystals belonging to the former system, Iceland spar, a transparent form of carbonate of lime, is the best, Fig. 2. If a black line is viewed through it, it is doubled; viewed in a careless manner, they seem to be just alike, but in reality they are very different and obey different laws. Thus, one is called the ordinary, and the other the extraordinary ray. Now, if the crystal is turned on its axis, the lines will come together until there is but one visible; continuing to turn they will again divide, until crossing the crystal at an angle they reach their widest divergency. Now let us substitute a black spot for a line, and we shall find something more has transpired than we were aware of, for now, instead of the spots receding and coming together, we find that one spot is stationary, whilst the other travels round it. Of course, the difference between this phenomena and the last, is only the difference between a point and a continuous line; the line simply revealing the horizontal but not the perpendicular displacement. But another difference may be observed. If we view the divided lines through another piece of spar, we shall find that in causing one piece to rotate, one of the lines will disappear at each quarter of a revolution. But the same appearance and disappearance may be observed in a very striking manner by viewing the lines through a bundle of thin glasses, Fig. 3.

This latter fact leads us on to another subject. Although Iceland spar is for many reasons preferred, yet other substances have the power of polarising transmitted light. Let us make two tubes like Fig. 4, with the ends cut off at an angle of 26°. In each tube must be placed a number of plates of glass. Common window glass will answer our purpose if we make the tubes large; but if we purpose using small tubes—say with a microscope—then the thick glass will not afford much light. In practice, I have found the thin glass used as micro covers by far the best. Now if we look through the tube B, we shall find no change visible in the light transmitted, yet a change has been effected of the most striking kind. This piece we call the polariser, and the light is polarised, although so far we can see no difference. Let us now look at the transmitted light through the second tube, A, which we call the analyser. Let the angle of the tubes lie in the same plane, still no alteration takes place. If now we turn one tube round so that the angles shall be perpendicular to each other, A, B, Fig. 4 —that is to say, let the tube be turned one quarter round—we shall find that the light has gradually disappeared, until, if there be several films of glass, the light is extinguished. Continuing to turn the tube the light will again be transmitted, gaining in intensity until the tube is turned halfway round. Passing on to three-quarters the light is again quenched, but gradually restored as we gain the starting point. We now arrive at a very important point, which is this—that the ray of light transmitted has two distinct sides or poles, and that in one position the films of glass offer no resistance to the ray, whilst in another position, a perfectly transparent medium refuses to allow the ray to pass. It is evident, therefore, that the ray of light is not in an ordinary condition, as the glass offers no impediment to ordinary light.

We are now led to make this inquiry: What is the optical condition of the medium through which the ray passes? The answer is this—that the ether surrounding the atoms of which the crystal is built up is in unequal tension in opposite directions, and vibrates at different rates. A sheet or film of ice is a familiar illustration. In the act of crystallising, the molecules arranging themselves according to a definite plan, render the ether less at liberty to vibrate in one direction than another. Between the horizontal and perpendicular there is an unequal tension. It will now be easily understood that a ray of polarised light—that is to say, a ray which has been split into two, and one half stands at right angles to the other—if it is transmitted through such a medium, will meet with difficulty in one direction, consequently the ray in that direction will be retarded. When tourmaline is cut in thin slices it will transmit a ray of light, but if cut in a certain direction it will allow the light to pass only in one plane, the ether being at liberty to vibrate in that direction only. Now let us suppose ourselves to be looking at a ray of light coming towards us, with the vibrations at right angles to each other, or polarised, B, Fig. 1. If the ray be viewed through a slice of tourmaline, those rays which are in the same plane with the line of transmission will freely pass, but those which are at right angles to that line will be retarded. If we cause the plate to revolve, there will be neither diminution nor increase of light, for as it gradually stops out the perpendicular rays, it will also gradually admit the horizontal.

Let us now place a second slice of tourmaline over the first with the plane of transmission coincident with the first; no change will be perceived, beyond a slight decrease in transmitted light occasioned by a portion being absorbed. If we now turn one plate round, Fig. 6, the light will grow fainter until the plates stand at right angles to each other, when there will be an utter extinction. Why? For this reason: The light being polarised, is transmitted in two planes perpendicular to each other. Thus the first film allowed but one set of vibrations to pass. The second being placed at right angles to it, cut this off, as the first cut off the other, the result being that no light at all is transmitted, and the centre of the crossed films is black, Fig. 5. Proceeding to turn the film round still further, the light increases until they are coincident. We have thus in a revolution two positions of transmitted light, and two positions of darkness. Instead of the films of tourmaline, we may use a Nicol prism, called after its inventor, which is a rhomb of Iceland spar, cut as indicated by the thick line F G, Fig. 2. The surfaces are polished and cemented together by Canada balsam. Now, as the refractory angle of Canada balsam is different to that of the spar, and as the ordinary ray is refracted at a different angle to the extraordinary ray, we can throw the ordinary ray outside the prism altogether, and so have the polarised ray only in the field of view; A B is the extraordinary ray; C D is the ordinary ray obeying the ordinary law of refraction; at D the ray impinges on the cement, which having a greater refracting angle turns it to E, and thus it fails to reach the eye. Let us now take two such prisms, the polariser and the analyser, or two bundles of glass, and place them at right angles, and so cut off all light. If now we pass a thin film of certain crystalline material between the polariser and analyser, we shall find that light is again transmitted. Indeed, it seems, as one has remarked, as if the film pushes away the darkness. Thin films of mica have this property, but that which is most commonly used in microscopic work is selenite, a transparent form of sulphate of lime. But many other crystals will do the same. In viewing thin sections of crystalline rocks, the writer has often seen the same phenomena. Certain crystals in the rock having this property lying at a definite angle transmit the light; whilst other crystals equally transparent to ordinary light refuse to transmit any whilst the analyser stands in that position; but when the analyser is turned round, the first crystals become dark, whilst others transmit the ray. We have again to inquire, how is this? Certain crystals are so built up that the ether can vibrate but in two directions perpendicular to each other. Now, it will be readily seen that if such a crystal be placed obliquely between, say, two tourmaline films, it will pick up some rays belonging to each side and transmit them; whilst if the planes of transmission stand coincident with the plane of transmission of either plate of tourmaline, no light can be transmitted.

Thus we see that so far we have come in contact with three systems of transparent crystalline substances; one, as common glass that vibrates in all directions; a second, as tourmaline, that vibrates but in one direction; and a third, as selenite, that vibrates in two directions perpendicular to each other. There is a further phenomenon yet to be explained, if possible. In using thin films of mica or selenite, we not only discover the phenomena just now referred to, but another and beautiful one—that of colour. Dependent on the thinness of the plate, so will be the colour, which will be of the richest hue; further on, turning the analyser or polariser, we find the colour fade, but instantly change to its complementary. It is understood that all light *under similar conditions* travels at the same rate, but that the length of wave, that is, the distance between the crests of the waves, A, B, Fig. 7, is different for each colour. Let us make a mental picture of two differently coloured rays of light, and we shall find that though they pass through the *same space* in the *same time*, yet the length of their wave is different.

"The shortest waves of the visible spectrum are those of the extreme violet; the longest, those of the extreme red; while the other colours are of intermediate pitch, or wave-length. The length of a wave of the extreme red is such that it would require 36,918 placed end to end to cover one inch, while 64,631 of the extreme violet waves would be required to span the same distance." *

We see from this, then, that there is a difference between the length of wave in the violet and red amounting to nearly one-half.

Taking an inch as a unit, then the distance between two waves of red light would be $\frac{1}{36918}$, and between two waves of violet, $\frac{1}{64631}$ of an inch. We have already endeavoured to explain the fact that certain crystals retard a ray of light in proportion to the angle at which it is transmitted and the thickness of the plate. Now, let us imagine a

* Tyndall, on light.

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ray of light traversing a crystal in such a direction that no obstacle is presented, then it is evident that all the vibrations will be transmitted, and white light will be the result; but let us now turn the crystal so that the power of transmission shall be coincident with certain rates of vibrations only; the result will be that the colour answering to those vibrations will be transmitted. If the light is retarded so that only vibrations the 36,918th part of an inch in length can pass, then the light will be red, and so on for every separate colour. On turning the analyser the complementary colour is transmitted, or that portion which has been quenched, which, united to the first, constitutes white light; so that, in revolving the polariser or analyser, the whole of the light is transmitted, but in two amounts—the balance due on the first is transmitted on the second.

In splitting off a film of selenite, somewhat as an amateur would do, a variety of colours will be visible, arising from the fact that the film is of unequal thickness. Sometimes they are so purposely arranged, that they shall make a kind of picture, say, of a flower—the leaves and flower alternating in colour as the analyser may be turned.

I think little more need be said on this part of my subject to help one to an intelligent comprehension of the use of the instrument I purpose describing. For more exhaustive details I must refer the reader to such masters as Tyndall, Spottiswoode, etc.

A SMALL SIDEBOARD WITH DRAWERS AND CUPBOARDS.

ITS ARRANGEMENT AND GENERAL DESIGN.

BY ALEXANDER MARTIN.

Construction and Details.

Before doing anything to the actual making of the sideboard, the design should be drawn out full size on a board, from which drawing all the sizes—lengths, breadths, and thicknesses—of the different pieces of wood may be obtained. This is the plan adopted in large establishments, and it is found to be the most convenient in every way; it saves time, and everything may be seen at a glance where it has to go, and how it is related to its immediate surroundings, so that nothing need be done haphazard or by guess. There is, therefore, far less chance of a mistake being made which may cost hours of work to put right; not to mention the waste of materials at the same time. In describing the drawings required to be put on a board, it may be advisable to state, first of all, that an end elevation of the sideboard shown in Fig. 1 (p. 377) is given in Fig. 2. This end elevation is drawn to a scale of 1 in. to 1 ft., or one-twelfth real size. All the other figures are drawn exactly one-half full size, so that to get the real size of any moulding, simply double the measurement it has on the paper. The detail drawings, from Figs. 3 to 15, are arranged—as regards numerical order—in the way the different parts would come under notice, when one begins at the top pediment and carefully examines the design downwards until he reaches the turned feet in Fig. 15, Fig. 3 having been the section of the moulding used in the pediment.

The size of the top measures 5 ft. × 1 ft. 10 in. Draw on the board then, as the first operation in the horizontal section through the cupboards, the half of this top—2 ft. 6 in. × 1 ft. 10 in. It is unnecessary to draw more than the one-half, as the other half is exactly similar. Next draw in the positions of the posts under the top. As the top projects $1\frac{1}{8}$ in., the posts must be kept that distance in on front and ends, but not at back, as the top does not project there. These posts are $1\frac{3}{4}$ in. square, and the two front ones have three beads scratched on their face, as shown in Fig. 13, where is also seen a section of the door stiles, rebated for the planted moulding, which again forms the rebate for the carved panel. This door measures 15 in. across to the division or centre gable, $\frac{3}{4}$ in. thick, and beaded as shown in Fig. 14. The position of the division between the two top drawers should be indicated, and it is also beaded on face as in Fig. 14. The outside gables are framed up with two rails and a panel, the latter being $\frac{1}{2}$ in. thick, and grooved into rails and posts as shown in Fig. 13. The back to the cupboards may be plain pine, *i.e.*, not framed up; but the back to the centre open space must, of course, be made of the wood the sideboard is made of. That completes the horizontal section through the cupboards.

A horizontal section of the back should now be drawn; and in order to save confusion, it is better to draw it on a different part of the board, or on another board altogether. Keep the outside posts of the back right above those underneath. The posts in the top part are $1\frac{1}{4}$ in. square, and have three beads scratched on their faces. They are also rebated for the side glasses, and the panels underneath them. In Fig. 6 is shown a section of one of the centre posts, showing it rebated for the side glass, and also showing the framing and planted moulding round the centre mirror. This mirror is 24 in. wide, so the daylight size inside the moulding should not be more than $23\frac{5}{8}$ in.; this allows for the necessary cover over the edge of the glass. Placing this size on the board in the centre of the space at command, the remaining space at each side will regulate the width of the side mirrors. The panels under the shelf are exactly similar to the glasses above, except that the side panels have a moulding similar to that put round the centre glass planted round them. The shelf is shaped on the front as indicated in Fig. 1, and is 9 in. wide at its broadest part and $5\frac{1}{2}$ in. at its narrowest, which is at its extreme end, where it is supported by brackets $\frac{3}{4}$ in. thick, see Fig. 2. The edge of the shelf is moulded, as shown in outline at the top of Fig. 10, where also will be seen the distance from the edge which the turned pillars are to keep. These pillars supporting the roof are placed right in front of the centre posts of the back.

Now upright sections are required. Begin with the top of the under carcase. It is 3 ft. 2 in. from the floor, and is moulded as in Fig. 11. This whole figure should be drawn exactly as it is, but double the size, of course, on the board. Under the top is a large moulding; then the drawer and its fore edge; then the door top rail, which is much wider than the door stile is, in order to receive the pediment which is glued on its face. The thickness of this pediment is shown to be sufficient to make it project slightly beyond the panel moulding. It has a hollow run out of it near its bottom edge, and the height of it at each end is indicated by a line across it about midway up. The centre is carved after the style of the carving in the pediment. Now, working from the floor up, the front part stands $2\frac{3}{4}$ in. clear of the floor, and turned feet are put on separately. These feet are drawn in Fig. 15. The bottom rail is placed 5 in. from the floor to its under edge, and it has three beads scratched on it, as shown in Fig. 12. In that same figure is given a section of the bottom rail of the door—broad as the top one was, and for the same reason—to receive the moulding and shaping on its face. For the carcase back there is a broad rail at the back of the depth of the drawer fronts, and also another back rail of same size as the bottom rail at front, and in the same position. Both rails may, of course, be pine, as they are not seen at all. Just indicate the position of the bearers for the centre drawer, which is lower than the other two, and this section will be finished.

An upright section is also required through the centre and through the side glasses; draw the centre one first. The shelf, 9 in. broad, is $9\frac{1}{2}$ in. high, and the glass is 22 in. high—that means a daylight opening of $21\frac{5}{8}$ in. The framing round glass and panels below shelf is similar to that already drawn in the horizontal section of the back. Note to make the rail behind shelf broad enough to show the proper margin above and below the shelf when it is put in position. The cornice is made separately, and rests on top of back framing and the two turned pillars in front. A section of it is given in Fig. 4, showing it built up of three pieces. The shaped pediment, $\frac{3}{4}$ in. thick, rises above that again, and has a moulding planted on it, a section of the moulding being given in Fig. 3. The upright section through the side glasses is exactly the same as that already drawn until the shelf is reached. Above the shelf the rail projects $1\frac{3}{4}$ in.; it has a plain margin of 1 in. wide, then a bead is run. On the top edge is formed a hollow and a rebate for the glass similar to that in the top rail which is above the glass. The side glasses are 10 in. high—$9\frac{5}{8}$ in. daylight size—and the rail above is shown in section in Fig. 5, the shaped bracket, $\frac{3}{4}$ in. thick, being above that again.

If any one think these directions and explanations are too fully given, it must be remembered that the drawings must be accurate, or they are useless, and these remarks so fully explain the design that the less remains to be said.

A list of the different pieces of wood required should now be made after this fashion:—

No. of Pieces.	Description.	Wood.	Length.		Breadth.		Thickness.
			Ft.	*In.*	*Ft.*	*In.*	*In.*
1	Top	Mahogany	5	0	1	10	$\frac{3}{4}$
2	Posts, front	,,	2	$10\frac{1}{2}$	0	$1\frac{3}{4}$	$1\frac{3}{4}$
2	,, back	,,	3	$1\frac{1}{4}$	0	$1\frac{3}{4}$	$1\frac{3}{4}$

The first column is for the number of pieces required; the second for the name of the pieces; the third for the wood—mahogany, oak, pine, cedar, etc.; and the others for the sizes. From this list every piece of wood required may be sought out and cut. The different pieces requiring jointing—as, for instance, the top and gables—should be shot and glued up. The outside gables are framed up, the panels being grooved in, and the posts mortised for front and back rails and fore edges. The inner gables are prepared to receive the bearers of the centre drawer, and are themselves pinned into the bottom rails and drawer fore edges. The bottom—which is in three pieces—is now put up from below; the centre piece of the bottom, being seen, must be of show wood; the other two pieces may be of pine. The mahogany and pine should be half checked underneath the inner gables and screwed to them, as shown in Fig. 19. Here

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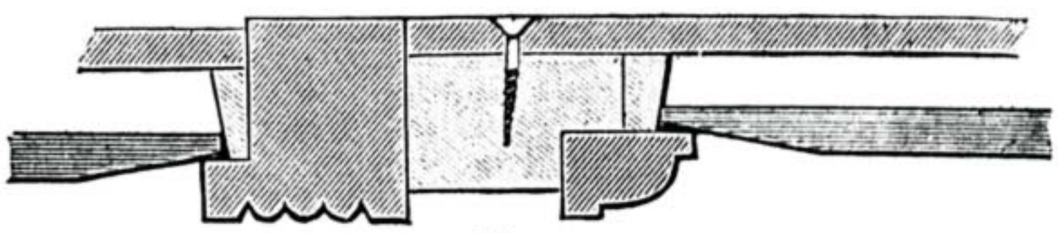


Fig. 6.

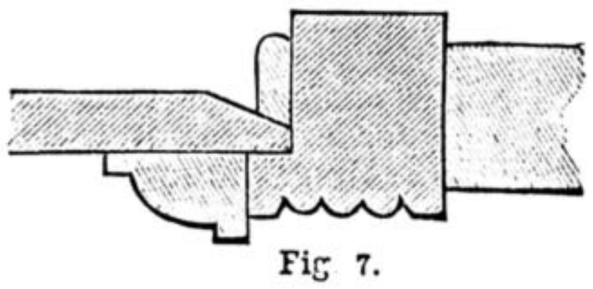
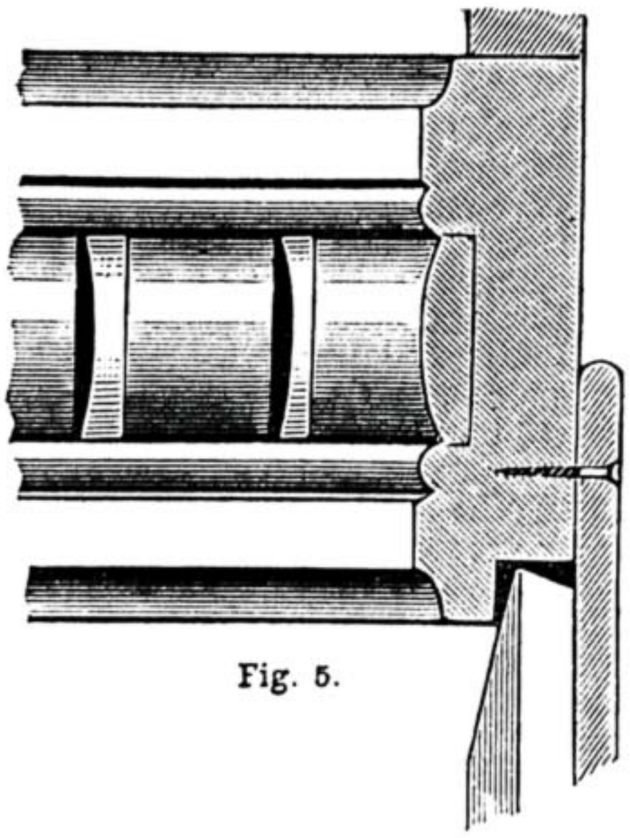


Fig 7.



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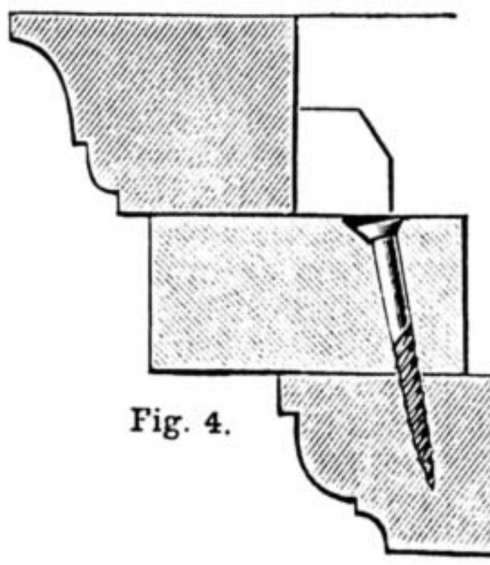

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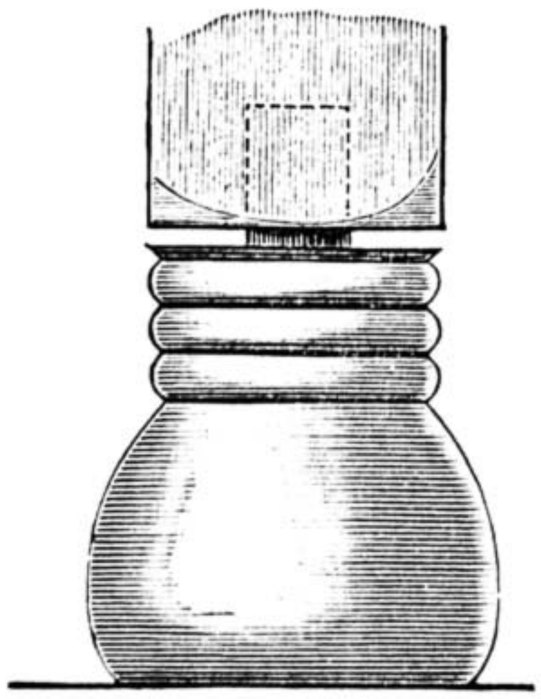

Fig. 15.

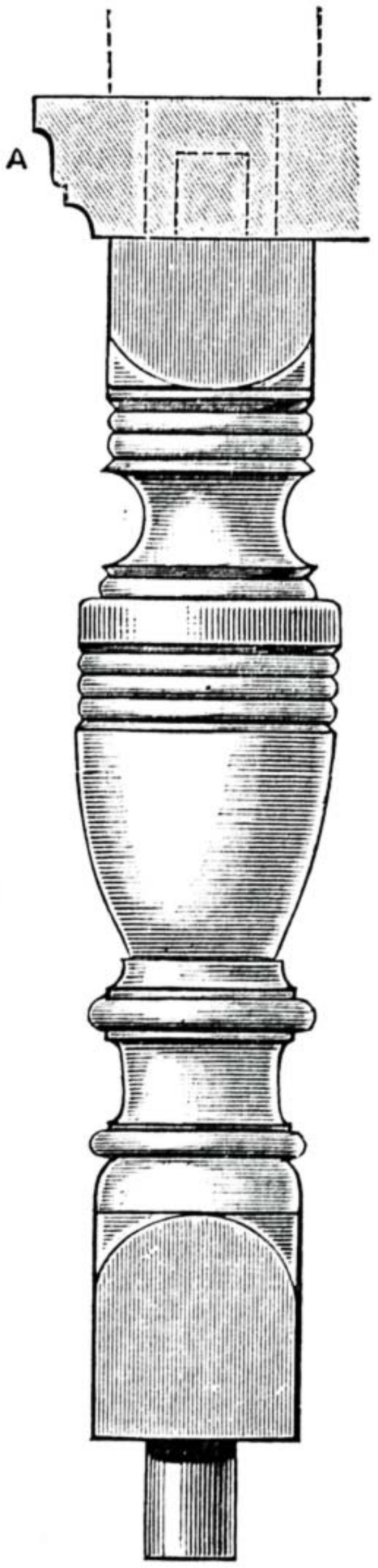

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Fig. 3.

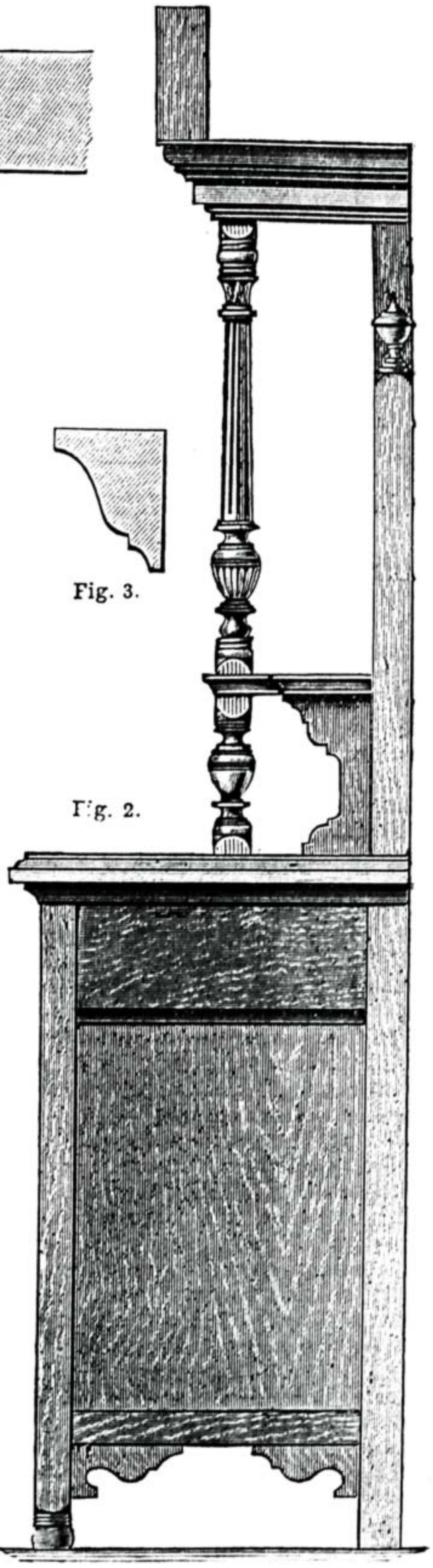

Fig. 2.

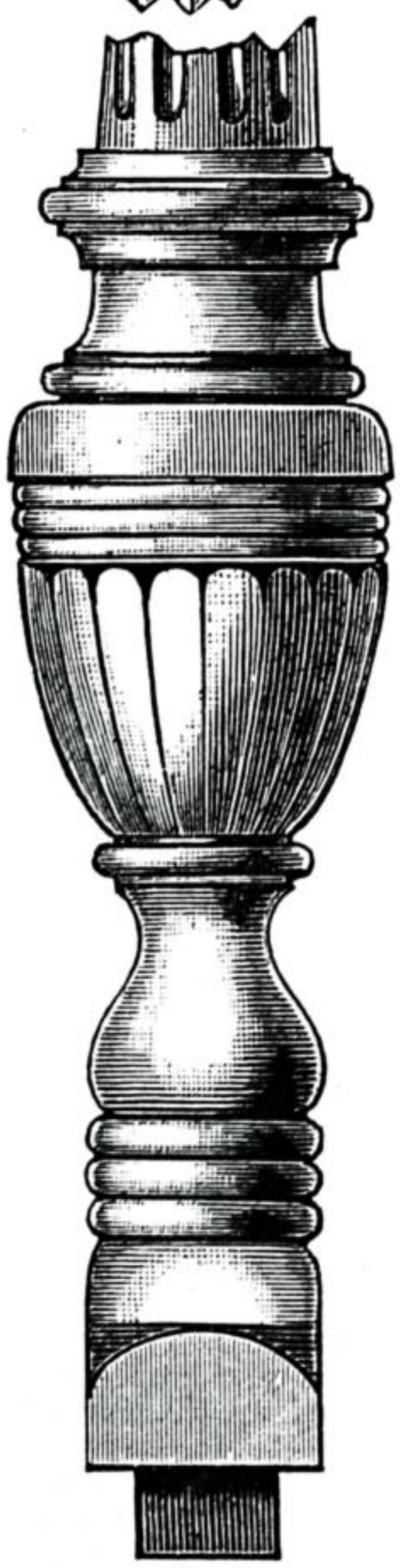

Fig. 9.

Fig. 8.

Fig. 10.

Fig. 2.—End Elevation of Small Sideboard: Scale, one-twelfth size, or 1 inch to 1 foot. Fig. 3.—Section of Moulding used in Pediment. Fig. 4.—Section of Cornice. Fig. 5.—Rail above Side Glasses in Elevation and Section. Fig. 6.—Section of one of Centre Posts, etc. Fig. 7.—Section of Post and Side Panel under Shelf, with Planted Moulding. Fig. 8.—Turned Finial in Centre of Pediment, and Pattern for Turned Knobs above End Posts. Fig. 9.—Turned Pillar supporting Roof and resting on Shelf. Fig. 10.—Turned Pillar supporting Shelf—A, Moulding of Shelf. Fig. 15.—Turned Foot for Cupboard.

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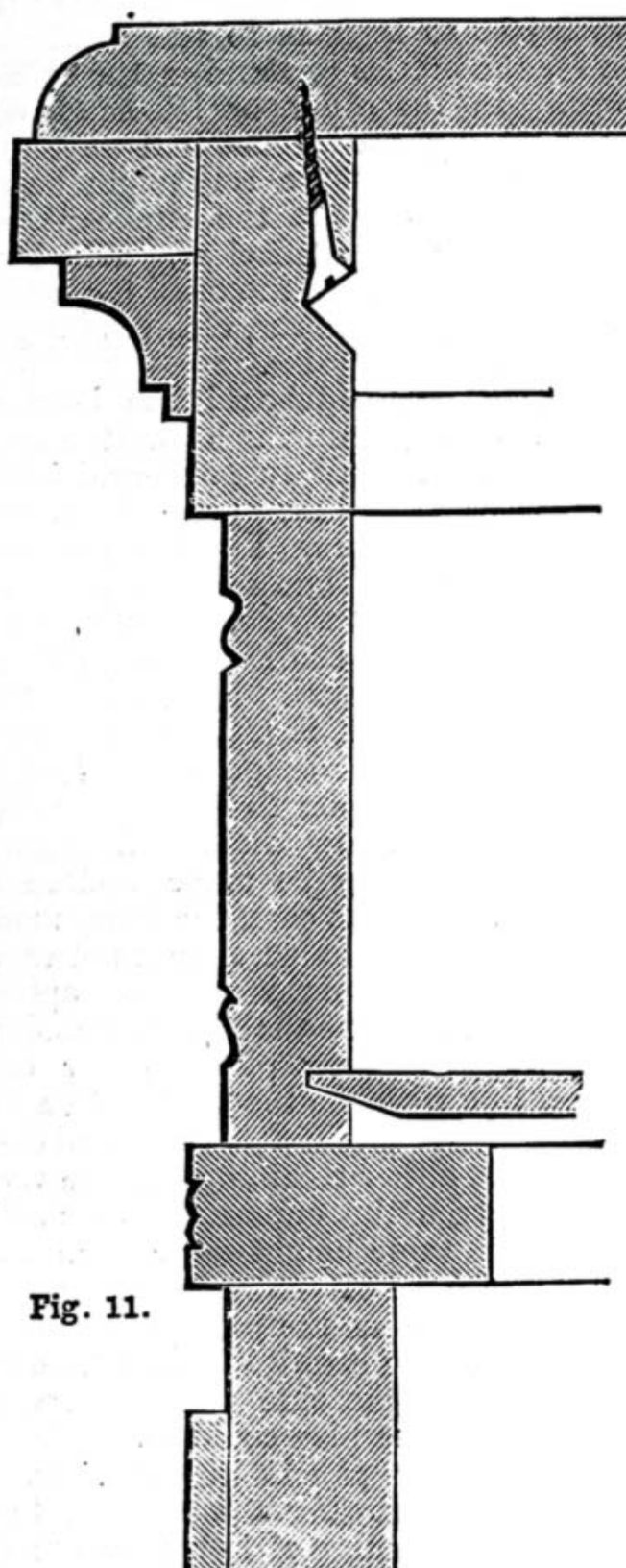

Fig. 11.

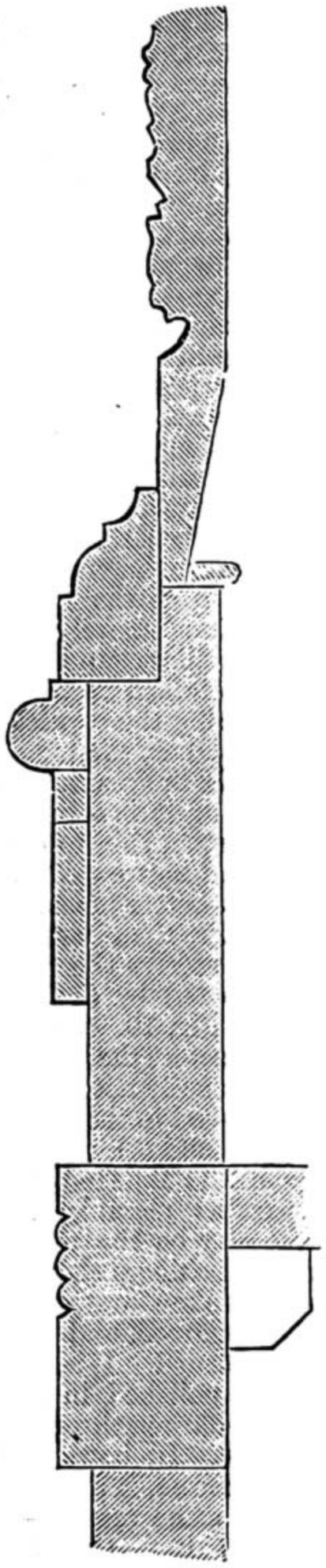

Fig. 12.

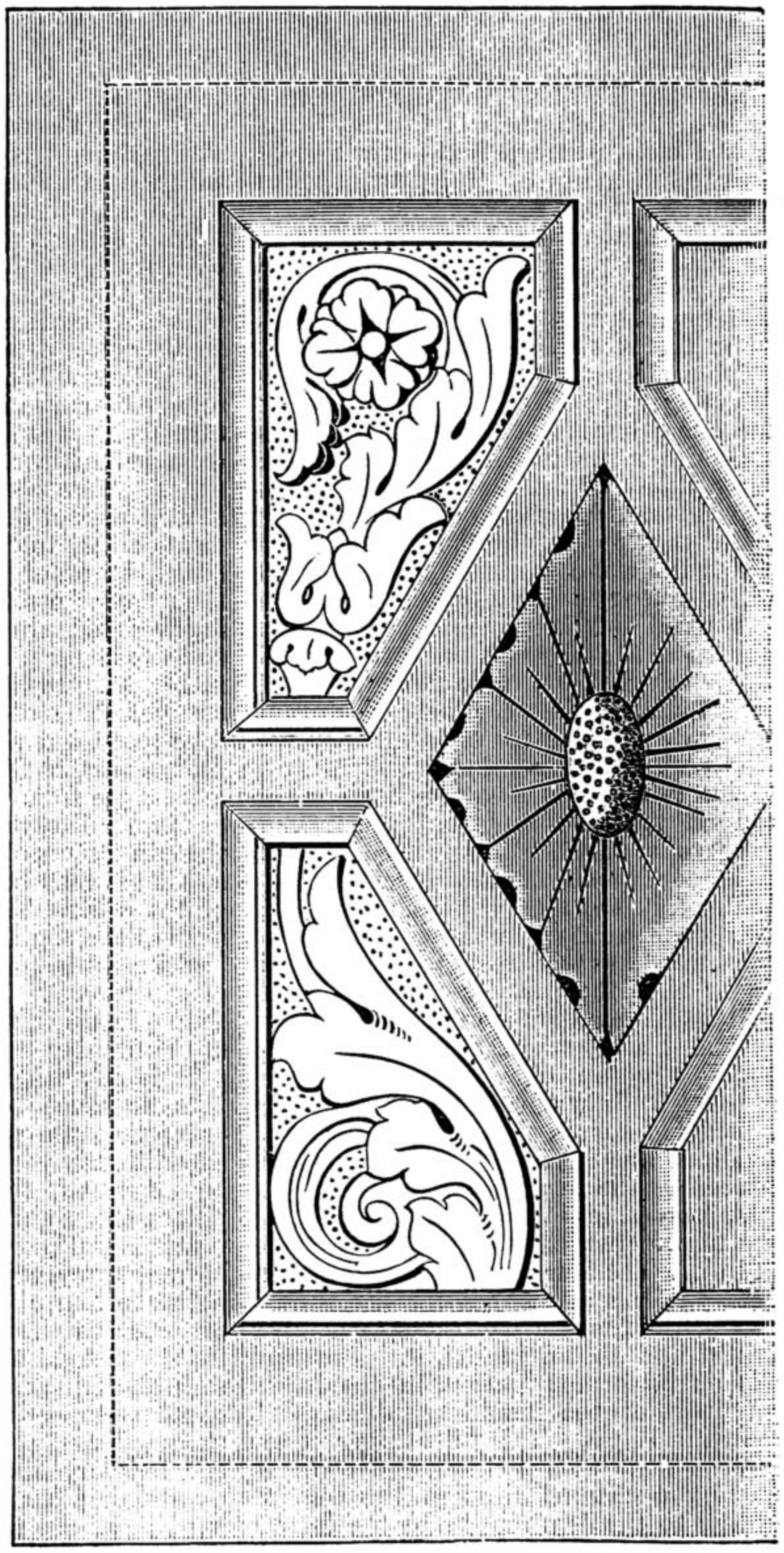

Fig. 18.

Fig 17.

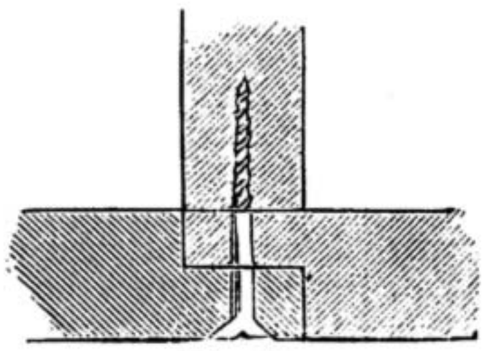

Fig. 19.

Fig. 14.

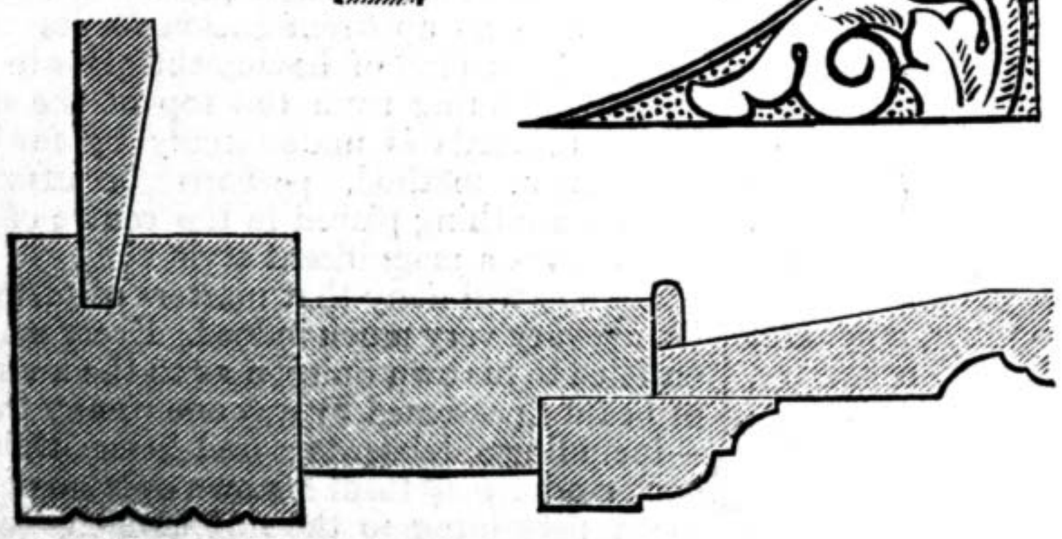

Fig. 13.

Fig. 16.

Fig. 11.—Upright Section of Upper Part of Under Carcase of Sideboard. Fig. 12.—Section of Lower Part showing Bottom Rail of Door, etc. Fig. 13.—Section of Post and Door Stile rebated for Planted Moulding. Fig. 14.—Section showing Beading on Face of Divisions between Cupboards and Recess and Drawers. Fig. 16.—Carving for Side of Pediment. Fig. 17.—Carving in Bracket above Rail over Side Glasses. Fig. 18.—Cupboard Door, showing Panelling and Carving. Fig. 19.—Diagram showing Half Checking of Mahogany and Pine under Inner Gables.

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notice that the right-hand bottom is the mahogany one, and the left-hand one the pine one. If they be reversed, the edge of the white wood bottom might be seen if the joint were the least bit open; the other way it cannot. The bottom is blocked at front, back, and ends, where it had better also be secured to the end rails. The carcase backs may now be put on: mahogany again at the centre; pine at the sides. The drawer bearers and guides are put in their places, and the drawers made. The doors may now be framed up and moulding planted, as indicated in the sections in Figs. 11, 12, and 13. The pediment and lower base moulding and shaping to panel add some little work to the door; but it is time well spent, as it forms quite a feature in the design. If, however, it be thought that there is enough work without this extra amount, it is easy to make the top and bottom rails of same width as the stiles are, making the carved panel, of course, a little bit longer. This carved panel is the principal part of the decoration of the door, but the extra mouldings and shapings above and below it have a great influence in effectively placing it before the eye. The brackets under centre drawer, and also those under bottom rail, are $\frac{3}{4}$ in. thick, and have the little scroll carved on them to carry out the line of shaping to a suitable termination, at the same time decorating the bracket. The turned feet, it has already been mentioned, are put on separately to the post. This is to save wood, as the feet are thicker in diameter than the post (see Fig. 15); and mark that the corners of the square posts are rounded away where the turning commences. For the carver's guidance, the door panel is drawn in Fig. 18, the reverse side being, of course, similar to that shown. The dotted line indicates the margin that is covered by the panel moulding when the panel is beaded into the door.

The upper part has not nearly so much work in it. The four posts are mortised for the cross rails, and rebated for the panels and glasses, and moulded on faces, as already described and shown in Fig. 6. The top rail is an important feature in the back, having part of the moulding "dentilled," as shown in Fig. 5. This "dentilling" may readily be done with a chisel, and consists in cutting a channel through the convex moulding to the depth shown by the dotted line in section in Fig. 5. It forms a capital enrichment obtained by means of a very little work. Above this rail is fitted a shaped and carved bracket, which is blocked into its place. A sketch of the carving is given in Fig. 17. The frame for the centre glass is mortised together, and dowelled between the posts. Notice that the frame goes from top to bottom, the shelf being placed against it. The rail behind the shelf is made broad enough to show the proper amount of margin both above and below it. The end posts have a turned knob at top, which is turned like that shown in Fig. 8. This figure illustrates the turned finial in centre of pediment, and is much larger than the other knobs should be; they should only measure about $2\frac{1}{2}$ in. high and 2 in. over their widest parts, in place of 6 in. high and $4\frac{1}{4}$ in. wide. The two centre posts are taken only to the underside of the cornice, it being made separately, as previously mentioned. The foundation of the cornice is a solid roof, over which the other members are placed, as shown in Fig. 4. This solid roof had better have cross ends put on it, mitred at front corners, so that end wood may not be seen in any part of the cornice. The pediment is fixed above top moulding of cornice, and is carved at sides, as shown in Fig. 16; and in the centre, under the turned vase, it has three flutes cut. This turned vase, finishing the centre of the pediment, is carved too, as shown in Fig. 8. The pediment being only $\frac{3}{4}$ in. thick, and with the addition of the moulding $1\frac{3}{4}$ in., it will be seen that this vase cannot sit on that narrow surface. It should be placed 1 in. back from the face of the moulding—*i.e.*, having its front surface exactly in a line with the surface of the pediment; and another piece of wood may be put in behind the pediment to receive the vase. This cornice rests on the back, and is supported by turned pillars at front. The shelf is screwed from behind, as also are the brackets at its ends. There should be a dowel in the bottom edge of the brackets near their outermost corner, to enter the top of the sideboard, in order to keep them securely in their proper positions. The pillars supporting this shelf are shown in detail in Fig. 10, and the larger pillars supporting the cornice in Fig. 11. In this latter instance, the long, straight shaft of the pillar is broken off to save space, but all the rest of it is shown. Notice that, as the shelf is rather thin to receive a pin from both top and bottom sides, as these pillars require, it is better to make the pin of one pillar stouter than usual, so that it may be bored to receive the pin of the other. This is indicated by dotted lines at the topmost end of Fig. 10. Blind backs must be provided to protect the backs of the mirrors. These are usually not more than $\frac{1}{4}$ in. thick, and are screwed to the back of the framing. (See Figs. 5 and 6.)

It is advisable, when all is finished, to take as much of it apart as possible, in order that the polishing may be the more expeditiously performed. The doors should be taken off, the panels taken out, the pillars, shelf, and cornice removed, and the brackets and pediment unfastened. If made of mahogany, it should be polished in its natural colour, allowing it to darken through exposure to the atmosphere. If, however, that be thought too slow a process, it may be stained dark at once. The same remark—about staining—applies to oak, if that be the wood used; and it may darken through age, but very slowly indeed. Walnut needs no staining, but the inside of the job will need it, at any rate where white wood has been used, whether oak, mahogany, or walnut be the chief wood.

The glass should, of course, have bevelled edges; there is scarcely any other used in furniture now. The handles should be nice brass mediæval ones; they are to be had readily. Handles are sometimes put on the cupboard doors, but they are not considered indispensable.

The interior fittings have been purposely left unmentioned till now, because they depend so much on individual requirements. One might want quite a different kind of accommodation from another. For instance one tray might be wanted in a cupboard, where there would be room for four; or a shelf in each cupboard might be deemed ample. By most people, however, a cellaret drawer would be considered necessary. This is usually put in the right-hand cupboard, and consists of a deep drawer—about 6 in. deep inside—with cross divisions in it, dividing the space into so many divisions, each to contain a bottle. This drawer, in good work, is lined with lead or zinc; but often it is only lined with green baize, and if the bottles be only moderately carefully handled, this should be quite enough. A shelf may conveniently be put in above this drawer, just so high as to leave sufficient room for the bottles to stand in the cellaret drawer. In the other, or left-hand, cupboard, a shelf placed about half-way up is perhaps sufficient; or a tray might be put in close to the top of the cupboard, and the rest of the space left clear. Whichever drawer or tray may be intended for holding spoons, knives, and forks, etc., it is a good plan to line it with baize.

Now that this sideboard has been described from beginning to end, it may be well to make several suggestions, in order that it may suit the greatest possible number of our readers. You know we want to please, not a few, but a great many; and the more successful we can be in this way, the more satisfied shall we feel with the results of our labours. Beginning, then, with the lower part, if a thrifty housewife, on being shown this design by her lord and master, take exception to the open base, as being likely to allow dust, etc., to gather underneath, it may be made a close one very easily. In that case, the base, moulding on top edge included, should not exceed 5 in. in height, and in this way the cupboard will be $2\frac{1}{4}$ in. higher—that being occasioned by the bottom being placed lower down and in a line with the top of the close base. The open centre might also be wished closed with a door, either retaining the drawer as shown between the cupboards, or making the door the same height as the others are. It might also be of the same design, with different carving in the panel; or it would be better to make it quite different, as then it would make the side panels more distinct. This latter plan could be carried out by forming four panels in the door, the outer framing showing a margin of $1\frac{1}{2}$ in., and the inner framing of $1\frac{1}{4}$ in., with mouldings mitred round panels as on other doors. These panels should also be fielded on their face side, and may either be plain or carved. In the writer's opinion, plain panels would, in this instance, be preferable.

In the upper part several alterations may readily be suggested. The projecting cornice may be removed altogether, and the mouldings and pediment be made flat against the wall. This is the usual method of making a sideboard back, and might be preferred by many. Then the shelf might not run from end to end, but might be underneath the side mirrors only, in which case they had better be shaped so that they are of the same width at each end—not broader at one than at the other, as they are in the present instance—and be supported by two brackets each, or by two pillars each; either way will do. The centre mirror might then be made to come right down, instead of having a plain wood panel there, with no apparent reason for its existence. This plan of having the glass in the centre extending from the top of the sideboard upwards is undoubtedly by far the commoner method, perhaps because it reflects anything placed in the centre of the top in such a magnificent style.

No one will deny that matters of taste, or liking, vary very much indeed. Every man is entitled to his own opinion as to the amount of beauty possessed by any one or any thing—including sideboards; and hence, though each reader may form his own opinion of the merit pertaining to the various suggestions I have brought before him, I feel sure he will, in common fairness, allow me to state that, taking all things into consideration, the design, as illustrated, appears to me to be the most attractive and useful of all.

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OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of* WORK *for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of* WORK *without charge, the notices given partake in no way of the nature of advertisements.*

82.—ROWE AND SMITH'S PATENT AUTOMATIC INDICATOR.

IT has frequently happened that passengers have met with accidents, often of a most serious nature, through leaning on or against the door of a railway carriage, which has been pushed to or has swung to, but whose handle has not been turned so as to prevent its opening by pressure from within. In such cases there is only one handle to the door, and that is on the outside, and this state of things prevails in railway carriages generally, although occasionally, and notably on the Metropolitan District Railway, there are handles within the carriage as well as without, from whose position it may be known whether the door is properly closed or not. However, as it has just been said, in the great majority of railway carriages there is only one handle, and as that is hidden from the view of those within it is absolutely impossible to determine whether the door is latched or not without trying it. This fact, and the mishaps occasioned through it, induced Messrs. Rowe and Smith, 3, Hawthorn Place, New Wortley, Leeds, to think out a plan whereby the state of the door might be always indicated, and the result of their joint labour was the production of the Patent Automatic Indicator, which is shown in position on the door—or, rather, the framing of the door—of the carriage in Fig. 1, the two conditions of the indicator itself and the means by which it is actuated being exhibited in Figs. 2 and 3.

The following is the description of the apparatus as given by the inventors and patentees :—"The indicator consists of a rod working in the groove of a casting which is affixed, not to the carriage door, but to the framework (*lintel*), into which the iron tongue of the lock, bolt, or catch engages when the door is fastened. Attached to the upper end is the indicating slide, on which are the words 'Open' and 'Shut' *or their equivalents*. The rod, A, is acted upon by the tongue, catch, lever, or bolt, C, of the handle or lock, and when the handle is completely turned, the door being closed, exhibits the sentence, 'THIS DOOR IS SHUT,' as in Fig. 2. Directly the handle is turned to open the door, a spiral spring causes the rod, A, to return to its normal position, and the warning, 'THIS DOOR IS OPEN,' appears as in Fig. 3. Should the door be closed, but the handle not turned, this warning still remains, thereby cautioning the passengers against leaning on the door, and continues to be exhibited until the handle is completely turned and the door secure. As the rod which works the indicating slide is fixed in the socket, it can be clearly seen that it can only work when the tongue, catch, lever, or bolt, C, enters or leaves the socket, and that, consequently, no matter how apparently secure a door may be, unless the tongue, C, of the handle is properly and fully inserted, the indicator invariably shows the warning, 'THIS DOOR IS OPEN,' the word 'Open' being in white letters on a red ground; the colour of the slide itself indicates danger."

There are many points in favour of the adoption of this invention by railway companies. Firstly, there would be no longer any cause of complaint that there is nothing within railway carriages, or coaches as they are called by all railway officials, to show in what position the handle on the outside may be, and the position of the indicator on the framing of the door inside the carriage renders the announcement that it conveys so conspicuous to all within the carriage, that any may see at a glance whether the door is properly closed or not, without having to open the window and feel for the handle outside, as at present, to find out the actual state of affairs. Secondly, it is simple in construction, and, therefore, not liable to be thrown out of working order, and it is easily affixed to any existing carriage; and, thirdly, if any one met with an accident by falling out of any carriage or compartment of a carriage to which the indicator had been affixed, blame would attach to the person thus falling out, and the Company would be relieved of all responsibility and claims for compensation, inasmuch as on their part all would have been done to prevent accident that could be done or could be reasonably expected by the travelling public as a safeguard. And this last point would be manifestly in favour of the railway companies, and should operate upon them as a powerful inducement to have all their coaches fitted with the indicator.

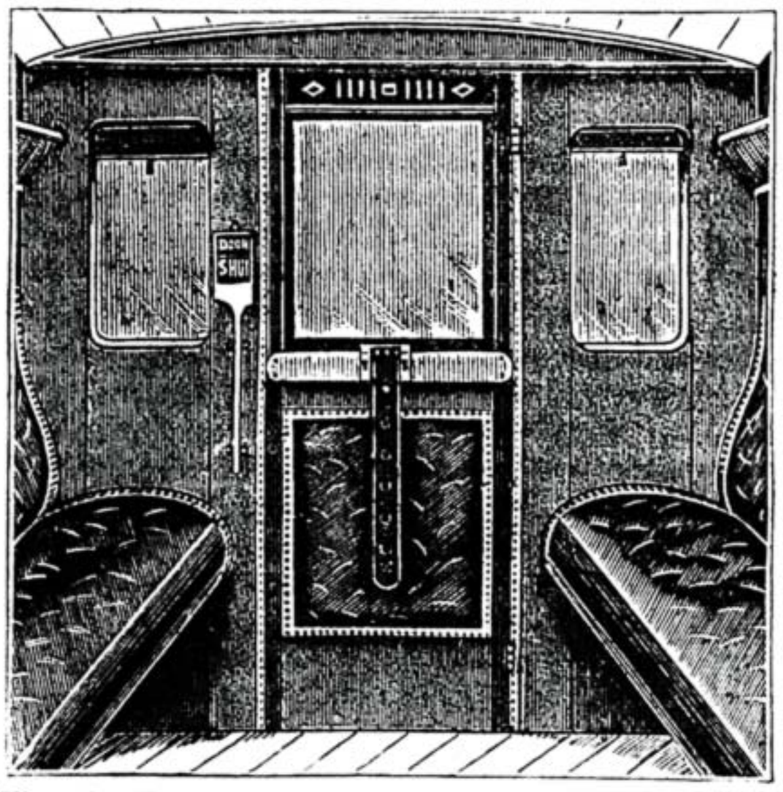

Fig. 1.—Rowe and Smith's Patent Automatic Indicator.

Fig. 2.—Appearance of Indicator when Door is Closed.

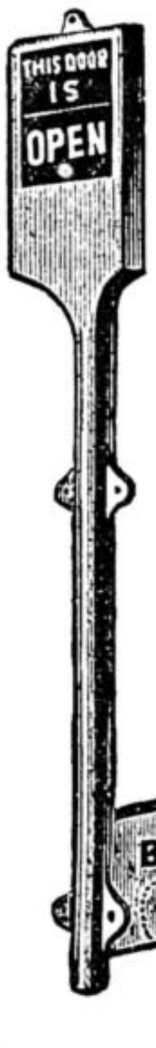

Fig. 3.—Appearance of Indicator when Door is Open.

83.—PITMAN'S CARVING TOOLS.

Mr. P. Pitman, Aubrey Road, Mauldeth Road, Withington, near Manchester, has sent me for inspection and testing a very handy little set of eight wood-carving tools, which he supplies for 7s., with strop and stone for sharpening the tools, specimens of carving, patterns and instructions, and some wood to practice on, so that any would-be beginner has it in his power to provide himself with a sufficient outfit and materials, and can commence operations at once at no greater outlay than the sum named. The set, as it has been said, comprises eight tools, of which three are chisels $\frac{5}{16}$ in., $\frac{1}{4}$ in., and $\frac{3}{16}$ in. in width; two gouges, $\frac{5}{16}$ in. and $\frac{3}{16}$ in. in width; two skew tools—one a chisel and the other a gouge—and one small V-tool or veining tool. The tools are of good quality, and will be found to be enough to make a beginning with, although when the wood carver begins to make progress he will find that a very much larger set is not only desirable, but absolutely necessary. For this Mr. Pitman makes provision by supplying a complete set of tools at 7d. per tool, if I read his letter rightly. The specimens of carvings sent with the tools are intended, as he says, to show the different stages of carving from commencement to finish. He has not sent me these on the plea that they are bulky in the first place; and, in the second place, would be uninteresting to me. With regard to the latter assertion I can only say that they would by no means have been without interest, and that a look at them would have enabled me to judge how far they would be useful to beginners, and to have given an opinion with regard to them.

Mr. Pitman also sends some instructions for the use of the tools. He does not say whether or not they are the instructions sent to beginners; if so, they are useful as far as they go, but do not amount to much. They are as follows :—"I give below a few instructions, which the pupil will do well to follow. The tools as they leave the workshop are not so sharp as they can be made, but the pupil must learn to sharpen the tools to suit the different woods with which he has to work. Place the tools on bench in order, and with the handles towards you. Keep the tools very short (*sic.; query* sharp). Learn to work with left hand in sharpening on the strop; the tool is pressed only on being drawn towards you. Amongst the tools will be found a V-tool, which is difficult both to sharpen and to use, so that beginners had better master all the other tools before trying their hand on the delicate V-tool. Practise on a piece of soft pine (like best pattern makers'), and work the tools with a wedge-like action—that is, cut all round your wood so that it falls away in chips, and do not *lever* it up or *break* it off, or you will ruin the tools. First try the chisel, and then learn the tools in order, the easiest first (*i.e.*, chisel), then gouge, skew tool, and V-tool. All questions sent to us are answered free."

There are three patterns of handles sent with the tools, one in beech, another in mahogany, and a third in rosewood. I prefer the rosewood handle myself, as the section lengthways may be described as an elongated oval, with the ends squared off and widest at about one-third of its length from the bottom. This form of handle is the most comfortable to hold, and affords the firmest grasp of the tool. Readers will kindly bear in mind that I consider the tools well worth the money asked for them, and the instructions useful as far as they go. I can say nothing about the specimens of carving sent out and the wood supplied for practice, as I have seen neither the one nor the other. It would be well if something were said in the instructions about the character and form of the wood-carver's bench and the means of fastening the wood down to it, for, in carving, it is half the battle to have the wood on which you are operating immovably fixed to a rigid bench.

The moderate price of the tools, etc., supplied by Mr. Pitman brings it within the reach of all who have an inclination to take up wood carving as a hobby to provide themselves with the necessary appliances in this respect. Few branches of the wood-workers' art are so attractive.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

*** Notice to Correspondents.—*In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of* Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Subjects for Work.—H. G. (*Oxford*) writes:—"I must pay my humble tribute to the merits of Work. I have read it from the commencement, and feel that it is filling a long-felt want. I wish you every success, as you most certainly deserve. I have derived help from your many valuable suggestions on different subjects, which I have greedily devoured, which has spurred me on to more perfection in my work, and I am certain others that you 'wot not of' must be in the same position as myself—viz., compelled to recognise you as our benefactor. I have induced several of my friends to take in Work, and they one and all state that it is the best pennyworth they ever invested in. I think that every reader of Work ought to at least induce one, if not more, of his or her (as I hope you have many lady readers) friends to become subscribers to your work. I shall continue to do so. There are one or two things I have been on the point of writing about several times, but have put off again and again, hoping to see someone else write about the same subjects. In the first place I must tell you that I am a man who is obliged to get his living at work which I had no opportunity of learning anything about, but have had to form my own notions and judgment as to how things should be done, and have done it, and am afraid I do not do them the easiest or quickest way. I refer to tin and iron plate working, and general repairs in connection with that trade. I was very pleased the other week to see that you have a series of papers on the above subject nearly ready for publication, and shall anxiously await their advent. I hope the tools of a tinman, etc., will be specified. The other subject I wish to write about is 'Grinding,' how to grind razors, scissors, knives, etc. I do a good many, but never having learnt how, I feel at a disadvantage in not knowing the best way, so should feel very much obliged if you would allow one of your readers, through 'Shop,' to state what kind of stone or emery wheel would be suitable for different classes of work (I only use a 3-in. emery wheel, coarse, for everything, and am afraid I am wrong, as work does not look nice when done), and how to hold them on the wheel, and what kind of machine would be best (I have a small lathe with a wheel fixed on spindle). I think, Sir, this would be a topic of interest to some of your other numerous readers, so am inclined to think that it would not be lost to all the rest, and only a benefit to the one, but a good many would share in the benefit. How to make and mend umbrellas is a subject on which I should like to see a paper."—[You will have seen that papers on the tin plate worker's art have been commenced. The other subjects you mention will be treated in due course—even umbrella mending if any reader can write on it.—Ed.]

Circular Saw Rigs.—J. (*Twerton-on-Avon*) writes in reply to G. E. (see p. 284):—"Replying again to the criticisms of G. E., *re* my reply on p. 172, surely any amateur can use a collar plate to tap a thread. Certainly there is not so much difficulty in cutting a thread thus as there is in striking threads in wooden chucks, yet plenty of amateurs can do that. Again, the recess behind the screw is not necessarily 'turned out.' It may be cast in with the rough hole for the threads; but if turned, it is not 'superfluous,' or troublesome work, 'with small results.' G. E. has apparently a poor notion of amateur skill. Further, if G. E. objects to 'cutting a thread in a saw spindle,' it does not follow that others have the same objection. Neither is the spindle made in brass 'too soft to be of much practical service.' What of the numberless brass chucks in use? Besides, one would not use soft brass or yellow metal, but rather engineer's machinery brass or gun metal; and there are plenty of such chucks which have been in constant use for many years, perhaps eighteen or twenty. And what is the essential difference between cutting and fitting a chuck and a saw spindle? There is none. As to wood for spindles. If a piece of hard wood will not keep true for several years—and that depends chiefly on previous seasoning—it can be trued up like a wooden face plate, or can be renewed; and I know a turner who has such wooden spindles in constant use, and has had them in use for several years. Then my critic says, 'The amount of steadiness given to the chuck depends on whether the face is true and ground flat.' Precisely so, as in the case of any other chuck. But as I have already said, the spindle may be assisted by centring in the poppet. Finally, as to the table, that is matter of choice. I gave tables both simple and elaborate to suit all readers."

"Guide to Good Things."—E. G. C. (*Bristol*) writes:—"It was in my mind, and I imagine in the minds of others, that 'Our Guide to Good Things' was a paid-for advertisement. Now that you have affirmed otherwise, you have established confidence between Work and its readers, and conferred benefits on all concerned. With such editing there is no fear that Work will flag in interest or circulation. Its readers will all think of it as 'a friend in need,' when its editor thus dares to make it 'a friend indeed.' Sir, I thank you."

II.—Questions Answered by Editor and Staff.

Lathe Driven by Single Belt.—J. F. P. (*Darlaston*).—You ask if we have ever seen a lathe driven by a single belt from the top shafting which can be started, stopped, or reversed, without interfering with the belt at all, or with the engine which drives it. The answer is that lathes driven by power are almost always driven that way; there is never a second belt coming down on to the cone pulley on the mandrel; the reversing is managed by a counter-shaft and two belts above, which countershaft receives motion from the main shafting in one direction or the other, according as it is driven by the open or crossed one of the two belts. Get some mechanical friend to show you the arrangement—there must be plenty of power-driven lathes in your town. Perhaps, however, you mean that there must not be the usual counter-shaft with striking gear, but that the "one belt" comes straight from the main shafting down to the pulley on the lathe mandrel. Then I must answer that I never saw such an arrangement, though I imagine how it could be done. By means of frictional gearing it would be neater, perhaps, yet there are many who would object to add any unnecessary complication to the mandrel and headstock.—F. A. M.

Castings of Lathe.—Lathe.—You ask where you can procure castings for a lathe of 1¼ in. or 1½ in. centres on which you can turn the inside work of the Egyptian trellis in No. 7, and stanchions for model yachts. Pray don't have such a small thing. I know of no lathes so small except for watchmakers. Don't have anything less than 3½ in. centres. That size will be equally suitable for the work you wish to do, and infinitely more generally useful. You can buy castings of 3½ in. and 3 in. lathes from almost any lathe maker. Go to your nearest ironmonger, and ask him to show you his price list. Possibly you can buy a finished lathe, second hand, for the same price you would have to pay for the castings, and if you are not a good workman having access to a good lathe this would be your best plan.—F. A. M.

Stereo Flong.—A Stereotyper's Apprentice.—Either a mangle or brush or both combined is proceeded with as follows:—Make a paste of 1 lb. of flour, ½ lb. of whiting, 2 oz. of melted glue, and a very little alum. Mix with water so as to make a paste of the consistence of cream, and pass it through a strainer. Take a sheet of blotting paper and paste it thinly and evenly all over; cover this with a sheet of tissue paper, taking care to rub it all over with the hand in such a way as to prevent its creasing. Then add two more sheets of tissue pasted in the same way. Turn the flong over and paste a sheet of wrapper or sugar paper on the blotting. Then roll it flat with an iron roller or a wooden ruler, and let it stand for a few minutes, when it will be ready for use. The fault you complain of is probably owing to the use of too much paste, or to its being unevenly laid upon the paper, or to the paste being badly made. Prepared paste for the purpose is supplied by Messrs. Harrild & Sons, Fleet Works, London; and by Messrs. Richardson, Racquet Foundry, St. Bride Street, London.—J. F. W.

Magnet.—C. E. P. E. (*Ebbw Vale, Mon.*).—A permanent magnet should at least hold up its own weight of iron. It has been found possible to greatly exceed this by carefully selecting, hardening, and magnetising the steel bars, of which magnets are made. The capability of a magnet to receive and retain magnetism depends very much on the quality of the steel and its hardness. It will lose a very large portion of its magnetism if allowed to lie about in any position, or if exposed to extremes of heat and cold, or if jolted or jarred. To preserve a bar magnet, it should be kept free from bad treatment, and be kept lying in a position coincident with the direction of the earth's magnetic current. Two bar magnets may be made to preserve each other's magnetism by placing their opposite poles together, and placing a keeper of soft iron across both ends.—G. E. B.

Leclanché Battery Gone Wrong.—G. E. H. (*Oldham*).—The spasmodic action of your battery cells is probably due to hard work. A Leclanché cell will not furnish a constant current for any great length of time. It will ring a bell for a few minutes, and then it must have a rest to recuperate itself. If you give it a long spell of work, it will take a long spell of rest (perhaps a day or two, as yours does) before it will be ready to work again. This sluggish recovery is made worse by having the porous cells quite sealed over, because then the gases set free at the carbon plates cannot readily escape from the cells as they should. See to it that there are clear ventilation holes in the pitch seals of the cells. Perhaps the fault is not in the battery, but in the bell or in the pusher. The set of these will vary sometimes with the state and temperature of the weather, if not properly made, and will then require to be adjusted afresh. It is also possible there may be leakage of current between the lines on the battery side of the bell. It is impossible to reply to your letter the same week in which you write it.—G. E. B.

Ayrton's Practical Magnetism.—A. B. (*Middlesborough*).—This work is not yet published by Messrs. Cassell & Company, Limited.—F. J. C.

Books on Mill Work.—Lover of Work (*Shepton Mallet*).—Several good works on mill work are published by Messrs. Spon & Co., 125, Strand, London, but there seems to be no book specially on corn and grist mills.

Electric Bell Parts, Tools, etc.—Platinum (*London, N.W.*).—As you are living in London you can easily make up an electric bell, without the use of a lathe, by buying the various parts, such as magnet cores, bobbins, pillars, screws, and gong at a shop where they sell such things. Messrs. Dale & Co. (who advertise in this paper) will be happy to supply you with any parts you cannot conveniently make for yourself. It is not necessary to increase the size of the metal frame for each increase in size of the gong; but it is only reasonable to have this proportionate to the other parts. Respecting tools required to make an electric bell, these and their size will be naturally suggested by the kind of work to be done. For instance, if you have a ¼ in. hole to drill and tap, and a ¼ in. screw to cut to fit it, you must have a corresponding sized drill, stock dies, and screwing taps, making allowance always for the cut of screwing tackle. Some day I hope to go thoroughly into the subject of electric bell making, and then I will do as you suggest about a list of tools.—G. E. B.

Brazing Band Saw.—G. (*Salop*).—I have not had any practical experience in brazing band saws, but have seen the operation described. It may be done with a blowpipe or by means of a pair of tongs made white hot. First warm the two broken ends and scarf them down with a file until the lap does not exceed in thickness the other part of the saw. Get some brazing spelter, or some very soft yellow brass, or some tinned brass pins, and reduce a small quantity to filings. Then procure some borax, and grind a little on a slate to a smooth paste with clean water. Mix some of the brass filings with the borax paste in sufficient quantity to form the joint, and place this on the scarfed ends of the saw. Bring the teeth together in their proper places, and bind the joint firmly with iron binding wire. Clamp a pair of warmed tongs or pliers so as to bring pressure to bear on the joint to keep it from shifting when the brass runs with the heat, and then proceed to heat up the joint either with a blowpipe flame above and a piece of charcoal below the joint, or by means of a pair of heavy tongs made white hot. If the latter, clip the joint firmly until the filings melt into it, then release them, and grip the joint with a pair of warmed tongs for a few moments. If the blowpipe flame is used, the source of heat should be from a broad wick oil lamp in preference to gas flame, because the flame from coal gas ejected on steel is said to make it brittle. In either case make the joint sure by gripping it with a pair of warm tongs as soon as the filings run into the joint. When the joint is cool strip off the binding wire, and make all smooth with a file. Perhaps J. H. or A. R. (*Scorrier*) will oblige with their opinion on the proper method to be employed.—G. E. B.

Electric Bell Battery.—Amateur in a Fix (*Nottingham*).—The "white substance much like white lead" that seems to eat away the leaden head on the carbon plates of your cells is an oxychloride of lead, caused by the chloride of ammonia from the cell below creeping up through the pores of the carbon plate and dissolving away the lead. As this white substance first forms on the lead next the carbon plate it soon shuts the head off from being in direct contact with the carbon; the current then fails, and the bell ceases to ring. To remedy this you must take out the plates, melt the lead heads off, soak the carbons for several hours in hot water (changing the water during the last hour) to dissolve out the ammonia and lead salts, then well dry the plates in a hot oven. Whilst still hot, dip the ends intended to have the lead head in melted paraffin wax, and hold them in it until the wax has gone well into the carbon. When the plates are cool, drill one or two holes through each to form a holding for the lead, and then cast the heads afresh. The paraffin wax (solid paraffin, obtainable through any druggist) will fill up the pores of the carbon, and prevent the salts from creeping up under the lead cap. Whilst the lead cap is still hot, give it a coat of Brunswick black or other black varnish, and let this coat overlap on the carbon about ¼ in. This will protect the outside from the action of ammonia fumes. Retort carbon is the carbon scurf got off from the retort furnaces of gas works, and is a much denser, close-grained article than the carbon represented by the cokes used in a blacksmith's forge. These last are useless for battery plates. Porous cells of earthenware are more durable and look better than those made of canvas, but canvas bags make very useful cells; and, possibly, the reason you find them work best, is because they offer less resistance to the current than those made of earthenware. Thank you for your kind appreciation of Work. Try to increase its circulation by making it known to your friends.—G. E. B.

Walnut Stain.—Centrebit (*Tullow*).—Vandyke brown, mixed with a little liquid ammonia and then diluted with water to the necessary liquidity and strength, or rather weakness, makes an excellent

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walnut stain of any intensity. Whether it will be the best for your particular purpose or not I cannot say, as you do not mention the kind of timber you wish to stain. Other inquirers please note, and do not be afraid of giving too many particulars.—D. A.

Cement Floor Laying.—R. S. (*Edinburgh*).—The foundation should be rammed solid; if any filling up is required, it should be done with hard dry material, and no lime rubbish should be in it, as this has a tendency to swell, and lift the floor; a covering of broken stones to pass through a 2-in. ring not less than 3 in. thick should be laid over the floor, leaving 2 in. or more, if required, for the concrete. The concrete is mixed with 5½ cwt. of Portland cement to 1 ton of crushed bricks, limestone, or slag, that will pass through a ½-in. mesh. It must be well mixed, wetted, and turned over twice, then laid on the broken stones, and levelled by means of a straightedge from pegs, or a board laid level at each side. It must also be well beaten down with a hand beater about 15 in. by 10 in. with a handle on the back, till quite level and fluid on the top; it is then left for a few hours till nearly stiff, when it is smoothed over with a plasterer's trowel. If laid outside as footpaths, it should be in squares not more than 6 ft., or it will crack; the harder and more solid the foundation is the less likely it is to crack. The quantity named will lay about 14 or 15 super. yards.—E.

Preparing Vellum.—PUZZLED.—To describe this practically demands rather an illustrated article than the space available in this column; but your queries shall, as far as possible, be answered. (1) The skins used are those of calves, kids, and still-born lambs. (2) These are unhaired either by steeping with lime, by sweating—*i.e.*, by hanging in a smoke house heated by a smouldering fire till fermentation sets in; or by soaking with dilute acids. As you seek a cleanly method you may, perhaps, prefer the last. The hair, etc., is scraped off with a two-handed unhairing knife. After this the skin is stretched in a "herse" (merely a square frame of four sticks joined at corners); strings from the edges of the skin to this frame allow of its being made quite tight, and it is well scraped with a half-moon knife to clear away all fleshy particles, dirt, etc. Next it is ground. The grain side is merely ground over with a flat pumice-stone, but the flesh side is rubbed over with powdered chalk before grinding. The half-moon knife is now passed over the skin to drain it; this makes it look whiter. Fine chalk is then rubbed over both sides, and it is put to dry. It has next to be pared down to a proper thickness—probably about one-half—with a sharp circular knife, and then pumiced smooth where required. Lastly, it is glazed with albumen—white of egg. (3) Tools such as the unhairing knife, half-moon knife, etc., you can doubtless get at any good tool shop, such as Buck's, Holborn Viaduct.—S. W.

Music Stand.—J. H. F. C. (*Bermondsey*).—I am glad my music stand has been approved by J. H. F. C. In reference to its cost, I think the material was purchased for about 5s. as follows:—Mahogany, 1s. 6d.; brass tubing, 2s. 3d.; wood for bosses, 3d.; scrolls for feet, 1s. 6d.; wire for rods, 2½d. In reply to his second question, I could not undertake to make another in the way of trade. As a minister my time is pretty well occupied, and I only turn to mechanics or science by way of recreation and for the love thereof. I do not know, but I hardly think a man could afford to make it for much less than 12s. 6d. or 15s.; as a matter of fact I know there are stands sold for 21s. not nearly so handsome, useful, or substantial. But why does not J. H. F. C. make one? There is nothing in it except the turned work that a man with one eye and two hands, backed by will power, could not accomplish without any mechanical training whatever. I have found it possible by patient care to do what has passed muster for professional work.—O. B.

Furniture Polish Cleanser and Reviver.—C. H. W. (*Hastings*).—I cannot understand how you find any difficulty in preparing this, and the only explanation that occurs to me to account for the substances not mixing properly is owing to some ingredient in the polish. I daresay you are aware that other substances besides shellac and spirit are sometimes used in making French polish, and it is just possible that one of these may be the cause of failure. Suppose you try a smaller proportion of polish, which I presume you have bought ready made. Though it will not form so good a mixture, you might use methylated spirit and omit the polish altogether. I may say it is not necessary to enclose a stamp, as all inquiries are answered in these columns gratuitously, though none can be sent direct by post. Neither you nor any other correspondent who can be helped in any matter coming within the scope of WORK need think you are "troubling" us.—D. A.

Shorthand.—CUPID (*Castlejohn*).—Shorthand will not be treated in WORK. Full instructions, however, for learning this useful branch of education are contained in Cassell's "Popular Educator," a new edition of which is now being issued.

Bell Hanging.—J. S.—I am not acquainted with any book on bell-hanging in the old style—that is to say, by cranks, wires, and springs; but the subject will be treated in due time in a paper or two by a contributor who is accustomed to the work.

Tables, etc., for the Construction of Measures.—J. S.—I will obtain the American book of which you speak, and see what can be done towards the construction of tables showing the contents of vessels in imperial gallons, according to depth and diameter. I am obliged to you for your letter, and regret that when giving your name you should have omitted your address. Kindly let me have it, as it may be of advantage to be able to communicate with you.

Wooden Teeth in Iron Cog.—X. Y. Z. (*Orkney*).—You should have informed me by means of a sketch of the shape of the teeth of the iron wheel into which your wooden teeth have to gear. Had you done so I would have drawn at once the correct shape of the wooden teeth required. In the absence of this very essential information, I must take a somewhat circuitous course in order to show you how you can obtain the correct shape for yourself. I must assume, as is the case nine times out of ten, that the teeth you require are of cycloidal form, in which case you will proceed as follows:—Get a sheet of white paper and lay it against the face of the wheel into which your new teeth have to gear, and so take a rubbing of the tooth forms. Fasten this sheet of paper to a board with drawing pins; obtain and strike thereon the correct pitch circle for the wheel; make a templet, as shown in Fig. 1,

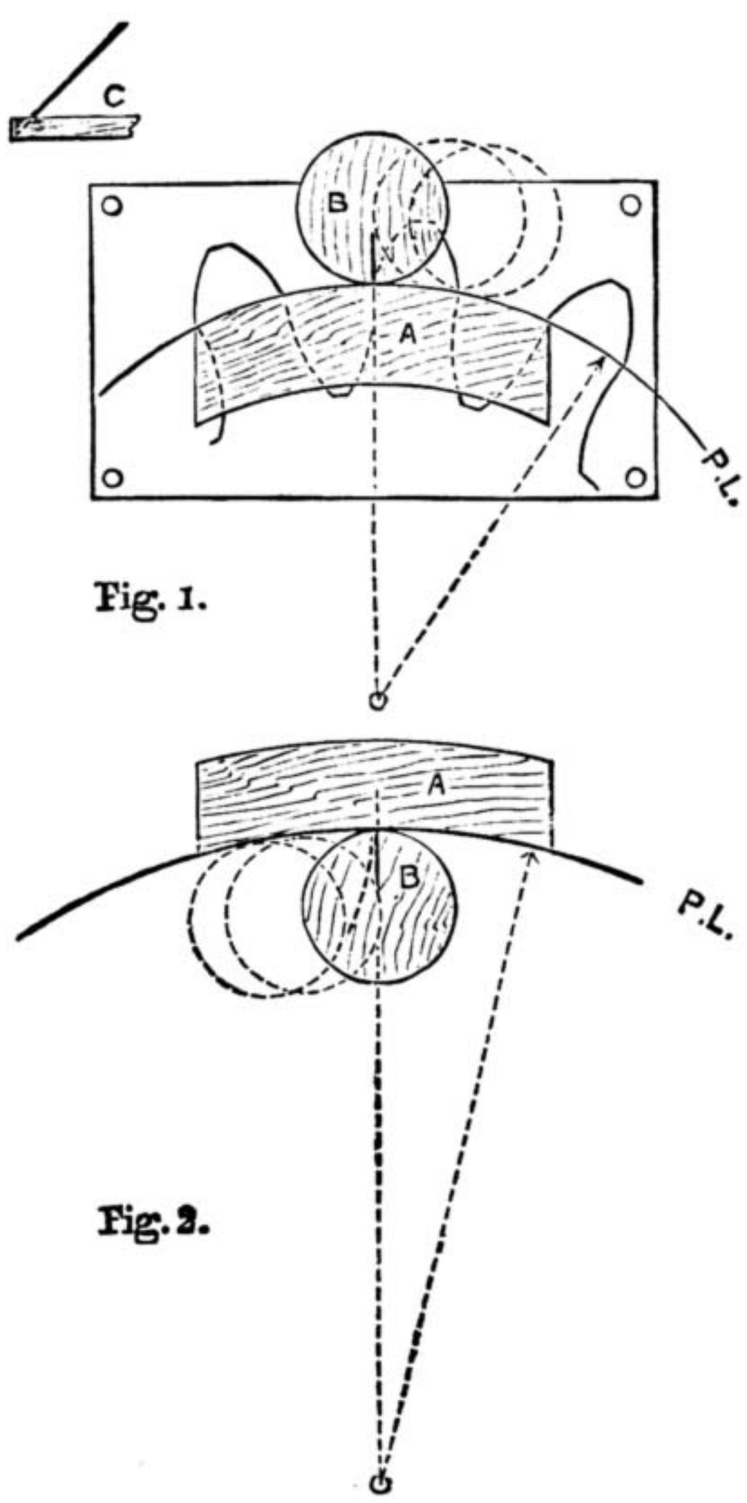

Fig. 1.

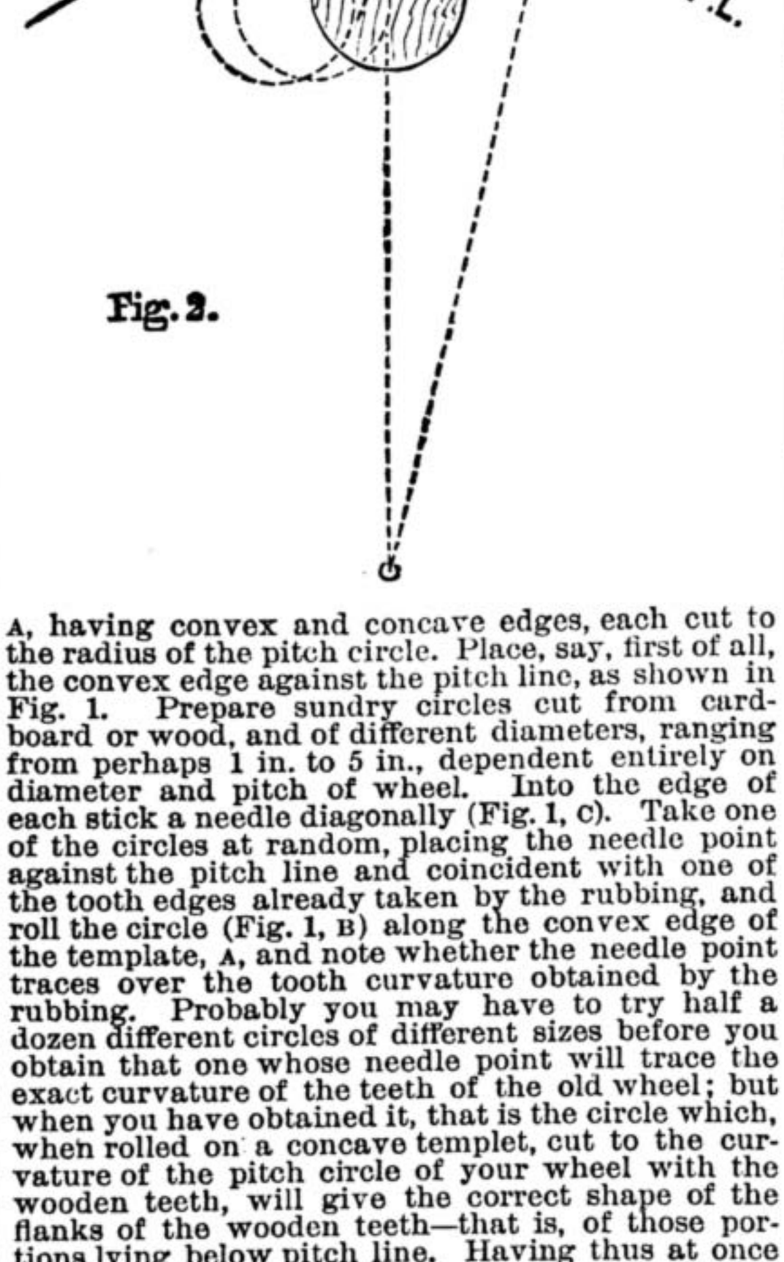

Fig. 2.

A, having convex and concave edges, each cut to the radius of the pitch circle. Place, say, first of all, the convex edge against the pitch line, as shown in Fig. 1. Prepare sundry circles cut from cardboard or wood, and of different diameters, ranging from perhaps 1 in. to 5 in., dependent entirely on diameter and pitch of wheel. Into the edge of each stick a needle diagonally (Fig. 1, C). Take one of the circles at random, placing the needle point against the pitch line and coincident with one of the tooth edges already taken by the rubbing, and roll the circle (Fig. 1, B) along the convex edge of the template, A, and note whether the needle point traces over the tooth curvature obtained by the rubbing. Probably you may have to try half a dozen different circles of different sizes before you obtain that one whose needle point will trace the exact curvature of the teeth of the old wheel; but when you have obtained it, that is the circle which, when rolled on a concave templet, cut to the curvature of the pitch circle of your wheel with the wooden teeth, will give the correct shape of the flanks of the wooden teeth—that is, of those portions lying below pitch line. Having thus at once found the proper curvature for the tooth flank, you can adapt a radius thereto by which to strike the planks of all the teeth in the wheel. To obtain the shape of the tooth faces—that is, of those portions lying above pitch line—you must place the concave edge of the templet, A, in Fig. 1, against the pitch line of the wheel of which you have taken a rubbing, and obtain the curvature of the tooth planks by means of a suitable rolling circle, precisely as you obtained the curvature of the faces, as shown in Fig. 1. Then the same rolling circle by which that curvature is obtained will, when rolled on the convex edge of the templet, A, in Fig. 2, give the shape of your wooden teeth above pitch line. There are other methods, more or less elaborate, by which tooth forms may be obtained, but there are none so suitable for workshop use, or so readily put in practice, as that which I have here given. It is founded on the mathematical principle of the cycloid curve, and the only departure from strict precision is the adaptation of a radius to the true cycloid curve obtained by the rolling of the circle on its base line. A cycloid curve cannot be struck mathematically true with compasses; but, excepting in the case of wheels of large pitch, the difference is quite inappreciable, and is not, in fact, so great as the slight inaccuracies inseparable from ordinary workmanship.—J.

Printing on Tin.—T. R. Y. (*Ramsbottom*) wants to know how to print upon tin and other hard substances, and asks me to mention some book on the subject. Books there are none, and every process for the decoration of metals has been patented, so I think T. R. Y. will get most information from the specifications themselves. These may be had from the Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C. Under the heading of "Letterpress and Similar Printing" are published abridgments of specifications of patents, which will guide the searcher to the full specifications as follows:—Part 1A, A.D. 1858 to 1866, 2nd edition, 2s. 9d. post free; Part 2, A.D. 1867 to 1876, 2s. 7½d. post free. These may also be seen at the Mechanics' Institute, Bolton, near which I think your town is situated. They can also be seen, free of all charge, at the Free Reference Library, Manchester.—N. M.

Hydroquinone Developer.—J. B. (*Brixton*).—I have read of such a deposit as you name being formed, but in my own experience it has rarely occurred. I do not keep notes of my developments, but I am under the impression that the grey deposit has only occurred with plates which have been under exposed and, consequently, forced in development, besides having been a long time in the developer. Mind, I only throw this out as a hint, as I am unable from my own knowledge to explain the defect you allude to, which, I take it, is somewhat analogous to the fog of ammonia. Perhaps if you were to try a different sample of the hydroquinone you might get better results, though, as you say the printing is not affected by the deposit, I hardly think there can be much wrong. You must be from what you say expert in the use of oxalate developer, so why change? It is a very good one, and as you have mastered it you will not find any others as easy till you have thoroughly familiarised yourself with their peculiarities. Thanks for good wishes.—L. I. P.

Polishing Rosewood Box.—J. S. (*Bradford*).—Without knowing exactly what materials you have used and how you have manipulated them when French polishing your rosewood box, it is impossible for any one to say positively why the polish always looks dull and greasy. I think, however, it is very probably owing to too much oil having been used either during the "oiling" or subsequent "bodying in" with polish. Rosewood, you no doubt know, is naturally an oily wood. If you will write again, detailing your process and describing more fully the appearance of the box, I will do my best to point out the cause of failure. The fault may possibly only be due to the natural "sweating" which is apt to occur on all newly polished work where oil has been used. Yes, the papers you refer to will appear as soon as practicable. They are in hand; but arrangements are made far in advance, and you know everything cannot be first. Meanwhile, any assistance I can render you in "Shop" is at your service.—D. A.

Door-Mat Method.—POWELL (*Londonderry*).—On reading your inquiry, another one, viz.:—

"Where can all this difference be
'Twixt tweedledum and tweedledee?"

occurs to me. If, as I gather, you are intending to make alterations, I am afraid you will find either of those you suggest to be more trouble than they are worth; but on this point you must be guided by circumstances. I would suggest that an easier way to manage is to cut the door at the bottom, so that it will clear a mat laid on the present floor and just under the door. Fill up the space or opening that has been made by cutting the door, by fastening a piece of wood to the floor. If practicable this will be the easiest way, and will save you the trouble of lowering the whole of your hall flooring. As for appearance of the two methods you ask about, it may be said that there is not much choice; and whichever you adopt, you are violating no canon of taste. This may not be so satisfactory to you as if I were to say that one plan is better than another; but were I to do this it would be only misleading you, as I should be entirely guided by many things which, without seeing your hall, I cannot know to offer a definite opinion.—D. A.

Window Blind in Turned Lattice Work.—C. E. P. E. (*Ebbw Vale*).—You write:—"Could you give me a rough sketch for a window blind of the ordinary size in turned lattice work? I only want the arrangement of the pieces, not to any particular pattern in turning, as I have a number of patterns in three panels." From this I gather that you want suggestions for the kind of blind known as a half blind—a blind that goes across the lower part of a sitting-room window on the ground floor to break the view of the interior to passers-by. You will find, I think, suitable arrangements in No. 7, page 98, and No. 18, page 281, for a half blind. A central

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panel within a border is the most fitting arrangement for a small window, but for a large window the central panel may be divided into three parts, or into a number of small panels like squares in a chess-board, the panels containing a different arrangement of pieces, so as to present a chequered appearance. Before beginning work you should construct a full size working drawing, and you can then arrange the border and panels to receive the decorative turned work in due proportions. I can only reply to you indefinitely as above, because you do not tell me the size of the blind you wish to make. Had you done so, I could have said something with regard to proportions of the various parts—border and panels; but it is no use assuming a size and replying hypothetically.

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Boot and Shoe Making.—NITRAM (*Boscombe*) writes in reply to FARNWORTH (see page 284):—"Go to any shoemaker's grindery store or leather shop, and purchase the following articles, which will do to finish the edges of your boots: one black heel-ball, one white heel-ball, small bottle of ink, sheet of 1½ glass paper, ditto emery paper or cloth, shoemaker's knife (thin blade), shoemaker's rasp, ditto man's forepart iron with one bevel, ditto plough, ditto paring up hammer, and ditto scraper, and get the man in the shop to sharpen this last article for you if you have never done so before. If you have to finish the heels you will have to get at least a heel iron, or, as I have heard some northern Crispins call it, 'a brazer.' If you do not know how to use the above articles, I shall be but too pleased to give any information on the subject at any time, with sketches if required."

Saws Running out of Truth.—A. R. (*Scorrier Saw Mills*) writes in reply to ALPHA (*Grangemouth*) (see page 286):—"Your swage saw should be 19th gauge tight at point of teeth, and 10th gauge at centre, bevelled from about ½ in. outside of collar washer. The saw must be kept perfectly round, and the set very even; ⅝-in. boards are rather thick to be sawn off with swage saw, though we often cut ⅝-in. and even ¾-in. with swage. A swage saw is not adapted for cutting off boards above ⅝ in. or ½ in. If the deal is not even on side next to fence, the first board will be thick, but if the saw is in good trim, the next will be its required thickness. Care must be taken not to overfeed the saw, and to spread the board a little as soon as it passes back of saw. You must remember that more care is to be taken in the working and sharpening of the swage than with a saw, that is of even thickness to get good work done. In fact, I know many sawyers that cannot work a swage saw so as to give satisfaction."

Gripping with the Vice.—SYER & Co. write in reply to CROSS-CUT (see page 222):—"One of our patent instantaneous grip joiner's vices would answer the purpose, as you can use 12 in., and instantly change to ¹⁄₁₆th."

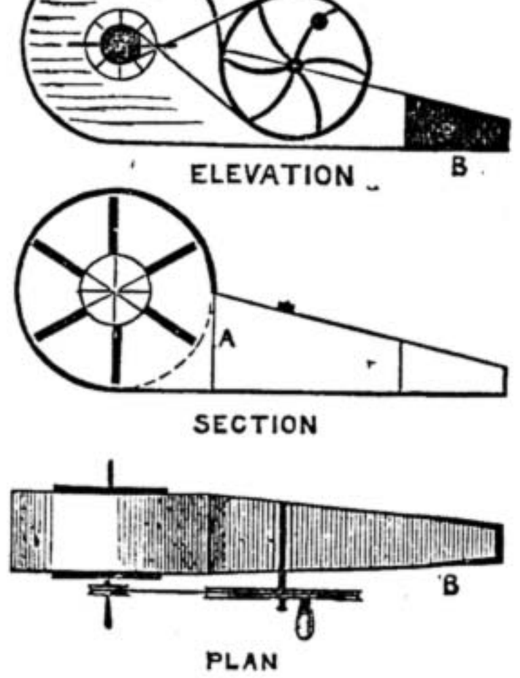
Colouring Photographs.—W. L. S. (*Walton-on-the-Naze*) writes in reply to EXPECTANT (see page 174):—"I have not had the chance to reply to the query of EXPECTANT (*Hull*), and I hope I am not too late. I shake hands with him in his profession, as I am presuming enough to style myself an amateur artist. Photos can successfully be coloured. A photo was shown me by a friend a few days ago of a group of lads four in number; it was a fairly sharp one, but a young gentleman of the number had a shadow somehow cast on his face, so as to give an expression about his eyes looking rather full, also of having one corner of his mouth drawn down. I was asked if I could remedy same, and tint the features, and button flowers, etc. I did so, my success giving satisfaction in such a degree as to have a set of half a dozen to manipulate with. I had but coloured one before, then I experienced some considerable difficulty in so doing. I reverted to a plan which I use when colouring cloth tracings, *i.e.*, rubbing my brush lightly on a piece of common yellow or mottled soap, the latter is the best, and then in the colour, and it will then flow freely and work easily on the photo. I should be greatly obliged if you, sir, would print my name and address with this small piece of advice, if you do not think it too useless, to enable EXPECTANT to communicate with me through your interesting and extremely valuable paper, especially 'Shop.' On oil or water colour sketches my experience is only of six months' standing, and self gained; but painting, as well as crystoleum painting, is a great favourite of mine, and a thing which I am pretty successful with, at least in my opinion and a few outsiders."

Blueing Steel.—W. P. (*Wisbech*) writes in reply to PALL MALL (see page 222):—"This is done in the tempering. It is by means of the colour that the temper of the steel is known. The colours run dark straw, light straw, crimson, dark blue, and light blue, after which the steel becomes quite soft, and requires hardening before anything can be done with it. The blue colour is almost too soft to cut wood, though quite hard enough for swords and daggers."

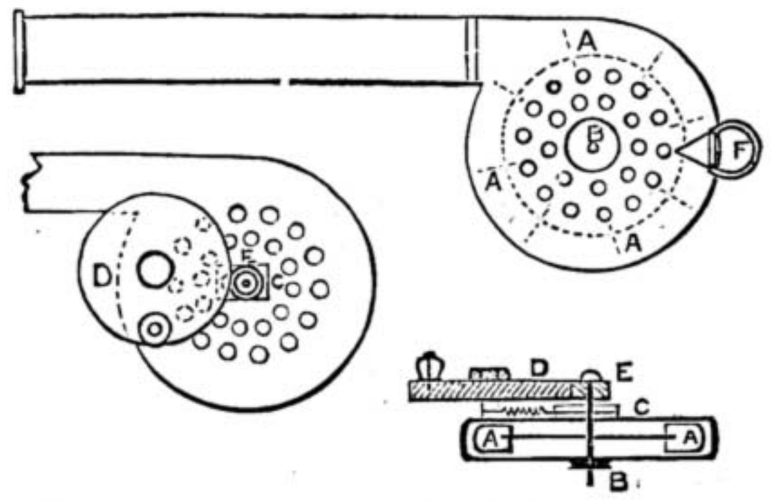
Flour Paste Souring.—X. M. T. C. C. (*Belfast*) writes in answer to J. R. (*Skerries*) (see page 238):—"To keep flour paste from getting sour, he might dissolve ½ oz. of alum to 1 lb. flour, which will make it keep for about a week. This is the only thing I know that will keep paste from souring."

Canvas for Painting.—H. R. M. (*Dover*) writes in reply to WAITING (see page 236):—"*Re* canvas for painting, I often experienced the same difficulties, which I at last got over by mixing a little flake white or even ordinary whiting with the size to the consistency of paint, and giving two or three coats according to texture of canvas, and allowing each coat to dry; well rub down with sand paper. It will then be smooth enough for painting."

Machine for Current of Air.—SCLATTIE (*Kemnay*) writes in reply to BELLOWS (*Gloucester*) (see page 190):—"With reference to how a machine can be made to give constant current of air, with rotary action, I submit the following sketch. Excuse the look of it, as it was done on the spur of the moment, after reading the number in which the question appeared. The machine is very handy to any one who would like to do any smith work at home, as with it light iron can be wrought, and even welded. The sketch, which is drawn to the scale of one-eighth to the inch, will explain itself, as far as size and general appearance go. Of the material, the sides may be of ½ in. deal to within 3 in. of nozzle, with a saw key run in where they bend. The top and bottom and round the blast should be of the thinnest of sheet iron; even tin would do, except at the nozzle, where it would require to be a little stronger. The journals and spindles are nothing but what a handy man might make himself. The pulleys the same."



Bellows with Rotary Motion.—G. E. S. (*Tonbridge*) writes in reply to BELLOWS (see page 190):—"I have one in my possession which works satisfactorily (but the worse for age in appearance only), and will try to describe it. It is made of tin plate, and measures 17 in. over all. The fan chamber is 6½ in. in diameter; the directing tube is 2 in. square where it joins the fan chamber, but changes to a circular shape about half way to the nozzle, the diameter of which is 1¾ in. Each side of fan chamber is perforated with two concentric rows of holes of ⅜ in. diameter, as near the centre as is compatible without weakening the plate. The inner circle of mine has eight holes, and the outer fourteen. The nozzle has a wired edge. I think a diagram will make the



driving arrangement more lucid than further description. The rim of the fan chamber is 1¾ in. wide; the sides are cut in one piece as far as the seam shown, and hollowed out a little. When fixed to the rim they make the chamber about 2 in. wide at the rim, and about 3 in. at the centre, on account of the hollowing out. A circular plate is notched to receive the vanes as at A, a brass bush is soldered on to take the spindle at B, a small bridge is made with a plot in the top for the spindle to be drawn into contact with the wooden driving wheel, D, which has a few fine grooves turned in its edge to better engage it with the small wheel at E, which is covered with leather, and is kept in contact with the driving wheel by a strong, cheap spring fastened to the spindle of wheel D, and also passing under the bridge to the spindle of wheel E. The loop, F, is for hanging up by when out of use."

Tuition in Carpentry.—A. L. O. (*Hammersmith*) writes in reply to AMATEUR (*Bayswater*) (see page 302):—"The gentleman (Mr. Robertson) whose circular I enclose can give the inquirer just the instruction he requires in his beautifully appointed workshop, 14, Augustus Road, Shepherd's Bush. I have only had twenty lessons from him, yet so extremely intelligent and intelligible are his methods of teaching that I have obtained a first-class certificate from Professor Unwin, of the City Guilds Institute, and have made a miniature bookcase 2 ft. 7 in. by 2 ft. for a collection of the various kinds of woods. AMATEUR could not do better, and moreover it is not very far from Bayswater."

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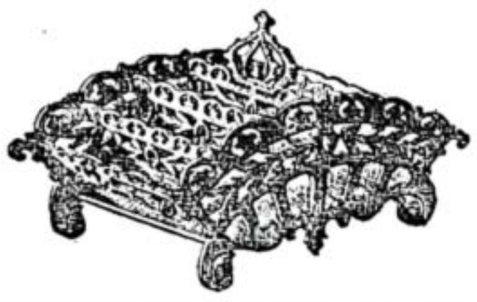

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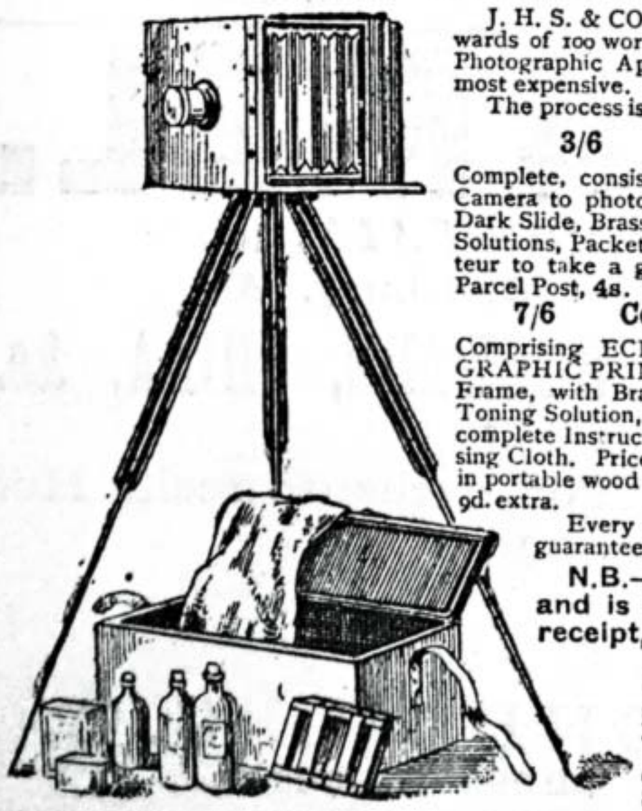

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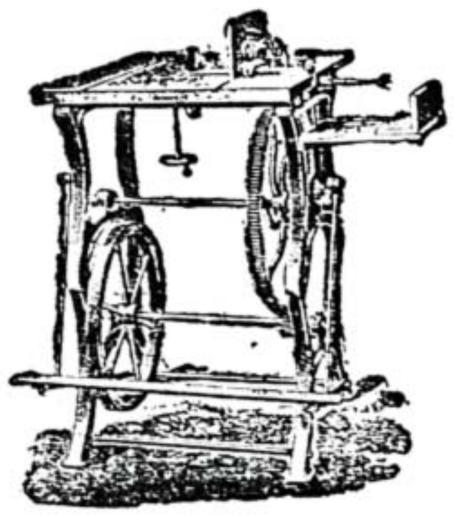

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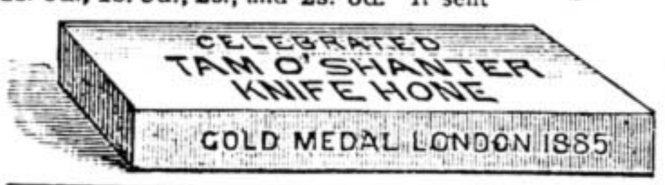

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